

## Concluding remarks and summary

J. P. M. BRENNAN\*

Ladies and Gentlemen, there are, I believe, two schools of thought about summaries: the first I can describe as the 'chance your arm' which consists of writing the summary before ever coming to the meeting, and be blown to what the contributors say. The second is the 'plodding-pedestrianism' one which consists in cobbling it up as one goes along. I am a lazy chairman, and the first method had considerable attractions for me but, unfortunately, I felt I did not know enough about the subject until I had listened to the speakers, so it really was not feasible. So you have to be content with the second, and you will deduce that at the moment I am suffering from an acute attack of illness, which I can best describe as mental indigestion. I am realizing the difficulty in taking in and summing up quite so diverse a series of papers as we have heard during the past two days — quite apart from the problem of condensing the plant history of three and a half thousand million years into something less than thirty minutes. So you will have to be content with a very disconnected series of remarks, not really a summary, but a sort of magpie assemblage of things that struck me as being particularly interesting in the papers that we have heard — plus perhaps, a few critical points, too.

I suppose nobody can work or be interested in a flora as rich and diverse as that of southern Africa without being tempted to speculate and think about the origins, migration and evolution of that Flora. In giving this summary I found that the meeting was so carefully structured, and so consistent, that I had little option but to follow the chronology of the papers as they were given, dull though this method may seem.

So, in the first place, I would like to mention Professor Raven's wide-ranging keynote address. The work, of course, of Raven and Axelrod in reconciling the theories of past continental movements and plate tectonics with the distribution of floras at the present day is well known and most valuable. It has the great merits of reconciling many problems of distribution, particularly in the southern hemisphere. It reconciles trans-oceanic affinities, for example between Africa and Australia, between Australasia and South America, and also others such as those between North and South America and the well-known Afro-American amphi-Atlantic discontinuities.

If I have any sort of very mild criticism, it is that I find it sometimes difficult to accept the rain forest flora of Madagascar and the relic forest areas in East Africa as a type of the forest that covered southern Africa before past climatic changes started to take

their toll. I must say, I think I would have expected more evidence in the way of relic species. I would also like to know a little bit more about how this theory explains the tremendous discontinuity, which is one of the striking features in my experience, between the flora of the Cape and the flora of tropical Africa to the north — enormous richness contrasted with comparative poverty.

I then come on to the pair of papers from Dr Knoll and Dr Anderson, dealing with the early history before the angiosperms came on the scene. I found Dr Knoll's paper a fascinating picture of life in those pre-cambrian days and, particularly interesting, in the glimpses that it gave of the rise of photosynthesis, surely one of the most spectacular events in the history of the world. I was also struck very forcibly by the extraordinary similarity of those very ancient fossil micro-organisms with apparent living relatives to-day — the similarity of Cyanobacteria and present-day stromatolites — that we were shown. I was also left with the thought that evolution must surely be proceeding at very different rates in the different groups of organisms, if those similarities are really valid. Dr Anderson took us further down the historical path from the Silurian to the mid-Cretaceous when the angiosperms came on the scene. I am not a palaeobotanist but, again, I found it a most exciting story of these successive mass rises and extinctions of conifers, psilophyta, lycopods and pteridosperms and so on. But, I am still left with the final climax in the mid-Cretaceous, when the previous groups disappeared and the angiosperms came: we can describe it, but I still feel that we are not explaining it very satisfactorily and, to my mind, it still remains that 'abominable mystery' as Darwin called it in the last century. I was struck with Dr Anderson's *cri de coeur* for more work to be done on the fossil plant material in southern Africa, for more collecting to be done, and for the results to be incorporated in a fossil flora of South Africa. Surely, an area as botanically outstandingly rich as South Africa, would find the bringing together of the evidence about its fossil history of extreme interest.

May I now come to the two papers dealing with the Tertiary history: firstly, by Professor Coetsee on the Tertiary pollen story and secondly, by Professor Boureau, dealing with the similar topic for north Africa. Again, an extraordinarily interesting part of the story of how the South African flora evolved. I was particularly struck by the presence of pollen belonging to the families Chloranthaceae and Winteraceae, and I cannot help bearing in mind the presence of living members of those families in the shape of *Ascarina* and *Takhtajania* in Madagascar at the present day and I see here support for the views put forward by Professor Raven earlier on. It is interesting to see too, in the Tertiary, that the

\*c/o Royal Botanic Gardens, Kew, Richmond, Surrey TW9 3AB, United Kingdom.

Proteaceae and the Restionaceae were already abundant, which seems to me to argue for a very ancient history of the rich Angiosperm flora of South Africa.

The other point I would like briefly to allude to is the poor acidic soil on which the fynbos of southern Africa flourishes — can it really be the cause of speciation, or is it just that this happens to be a refuge for many species? I feel that sometimes we might be putting the things the wrong way round. Professor Boureau's story of the vegetation cover of the Sahara during the Tertiary, as deduced from the abundant fossil wood remains there, to me, again, was extremely interesting. I noted particularly, with a number of genera that he mentioned, although he gave them as form genera (I am deducing their affinities) — *Lovoa*, *Entandrophragma*, *Pterocarpus*, *Calpocalyx*, *Erythrophleum*, etc.; all these genera are at present quite typical of the West African forest regions; only, I think, the genus *Nipa* mentioned by Professor Boureau seems to strike a strange note. Was thus the Tertiary forest flora of the Sahara all that different from the rain forest of West Africa to-day? One would like to know more about this, and for a more critical comparison to be made. Given that composition of the Saharan forest and given the composition of the forest of that time in South Africa, there seem to be great differences which one would like to be explored and explained in a little more detail.

May I now come onto the two papers dealing with the Quaternary history of south-east and north Africa. Professor Van Zinderen Bakker gave a masterly summary of the importance of palynology and climatic changes. I was very interested in the way in which differences were emerging between the northern hemisphere and the southern hemisphere and these, I think, are very strongly reflected in the present-day floristic composition in tropical Africa, north and south of the equator. One cannot deal with large widespread genera in Africa without being struck by this remarkable difference in many savanna genera, where comparative specific poverty north of the equator contrasts with specific richness to the south.

Professor Maley described the pollen studies that he had made in the Sahara, and, again, emphasized the importance of climate, particularly, climatic fluctuations causing floras to advance and retreat; he referred also to the interpenetration of tropical and mediterranean floras, a feature which has been mentioned again by Professor Quezel this morning in relation to the present day. Dr Vogel was trying to analyse past climatic changes by novel means, the changes in the ratios of isotopes in a number of different substrates. I found this a fascinating story, although I think that it is still rather imprecise chronologically and there are other uncertainties of interpretation, but it is certainly a potentially powerful weapon which one hopes to see developed in the future. Mr White gave us a long and stimulating paper on how to interpret plant discontinuities — are they really relics of continuous ranges or are they evidence of long-distance dispersal? This is, of course, a matter of long

standing argument among plant geographers. Certainly, I feel that the importance of accidental long-distance dispersal has been inadequately assessed. Before Christmas, I was in the Hawaiian Islands whose flora, highly endemic, since they are volcanic islands of relatively recent origin and far distant from any land mass, must have been exclusively recruited by long-distance dispersal except for those plants recently introduced by man. So certainly, this factor is an important one. One can argue about individual cases, but I think that Mr White's paper was an important corrective to certain trends in phytogeographical thinking. I find it difficult, however, to accept the theory of long-distance dispersal for all instances: I am, for example, rather unconvinced that *Hymenaea* drifted across the Atlantic and somehow landed up in Madagascar. It may be that it's been extinguished on the mainland continent of Africa in the intervening areas but, nevertheless, I feel that one has got to look at each case critically. But, certainly, the other point that he made about geographical speciation is, in Africa, a very important one.

Professor Werger dealt with the interrelationship of vegetation and plant communities to history. I found his paper extremely stimulating, particularly the ideas he put forward about the correlation of climate, rainfall and temperature with aberrant vegetation types. I am not entirely convinced that we are always correct in looking at islands of vegetation outside their normal distribution areas as evidence of past climatic changes; may not these be normal features of an advancing vegetation type or could they not occasionally be normal indicators of an ecotone boundary? I am putting forward these questions as they represent doubts in my own mind. Sometimes the answer is clear, but sometimes I feel it is not.

Professor Quezel's paper on the origins and evolution of the north African Flora, with all its complexity of different phytogeographical elements, again interpenetrating as we have heard, was a fine contribution. I was interested to see his mention of a northern tropical dry element, common to north Africa and north-western America, of which I think genera such as *Rhus*, *Cleome*, *Vitex*, etc., might be considered examples. I just wonder, however, whether it is right to consider that as a north African/north-west American element, but rather as an ancient relic existing in many dry areas in the world. Certainly, *Cleome* is typical of dry areas throughout Africa and also exists in other continents and I suspect the same thing could be said of other genera. Whatever one calls it, I think it is a component in the African flora of great importance in interpreting its history, and I would suggest that even a genus such as *Acacia* may be a member. I would also like to emphasize what Professor Quezel said about the mountains in the Central Sahara as possible pathways of migration for species and genera from north to south. One cannot but speculate about the presence of *Erica arborea*, for example, on the mountains in Malawi without wondering how on earth it got there; certainly a route from the Mediterranean across the mountains

of the Central Sahara would seem a feasible theory. Conversely, one cannot help also speculating about whether perhaps the species of *Erica* with which we are familiar in Britain and northern Europe may not really be northern outliers of the fynbos which have somehow reached there by some such route as that. The mention of the Canaries and their richness which has come up again in discussion was also significant and I am mindful of their effect as a possible source of flora of the east African mountains. I am aware of course of *Canarina*, that endemic genus which jumps from the Canary Islands to Ethiopia and then down to east Africa, and I think that *Sibthorpia* is another genus in that group.

Later this morning we heard papers on the phytogeography of individual groups, particularly the ferns by Professor Schelpe and the grasses by Dr Clayton. Professor Schelpe's paper was a healthy corrective to our preconceived ideas that fern spores must be able to get everywhere, and I was fascinated by his examples both of narrow endemics and discontinuous distribution. It does seem very strange that one should get amphi-atlantic distributions such as that of *Woodsia montevidensis* and, the question that arises in my own mind after hearing this is, why should these endemisms and discontinuities occur? Surely the clue to these must be in the ability of spores to travel long distances, their ability or inability to survive low temperatures, and their ability or inability to colonize the substrates on which they land, and the same applies to the subsequent prothalli. It seems to me that this could be a most interesting field for precise experimental work and that we might then well be on the way to explaining with certainty just why these strange phenomena occur.

Dr Clayton described the way in which he has interpreted the distribution of grasses on a world-wide scale in relation to the history and evolution of the African flora. The way in which his differential analyses of the distributions of tribes, genera and species revealed the way in which the oceans become a progressively greater barrier to distribution, is to be specially noted. I think that

similar results will be obtained from many other big families. His conclusion that the grass flora of Africa is almost exclusively palaeo-tropical is in accordance with my own conclusions for Leguminosae. I have found that the American element, in doing a generic analysis of the tropical African Leguminosae, a comparatively unimportant one. The only point of criticism I would make is his theory that the Camerouns Mountain may have acted as a barrier to migration between the two sub-kingdoms (which he correctly defined in relation to West Africa). I have been in that area myself and I found that the barrier or boundary, seemed to be a good deal to the west of Camerouns Mountain — rather in the Cross River area.

Finally, I must come to Mr Oliver and his collaborators' paper, on the distribution maps of Cape endemics. I must, most warmly, congratulate him on the very careful painstaking work, represented by these maps. They look simple when displayed on a screen but, my goodness, the amount of detailed collation, detailed patient examination of specimens and of maps they represent, is tremendous, but their source is going to be as a quarry from which one can obtain stones for building the structure of the distribution and history of South African taxa — something which I am sure most urgently needs to be done.

I suppose that I go away from this meeting with a feeling of tremendous gratitude to all the speakers and contributors. They have certainly given me a very great deal to think about. I think more importantly — and I think that this is perhaps one of the main functions of a Symposium such as this — they have indicated the problem areas of the future and there is where I think our task now lies — to continue the work so ably outlined during these past two days — to try and fill in some of the gaps. Well, I personally am willing to take small bets that this theme or something following it on is going to be a continuing subject for future AETFAT Conferences and that it is going to figure on the programme for the next one. Thank you very much Ladies and Gentlemen, for your forbearance.