The bronze age is divided into two epochs. The close of the first corresponds to a former beach elevation of not more than 3.5 meters higher than the present. At the close of the second epoch, the beach line was probably the same as it is now.

In an interesting table, Professor Brøgger gives the results of his attempt to measure the lapse of time since the maximum post-glacial submergence. His basis of reckoning is as follows: (1) The rate of elevation was about the same at the beginning as at the close; (2) the rate during the middle period of elevation was greater than at the beginning or close; (3) the determining of the position of the beach lines at the beginning and end of the bronze age and at the beginning and end of the closing epoch of the stone age, compared with the estimates of archeologists as to the absolute length of the bronze age and the last epoch of stone, gives a standard of measurement for the rate of elevation during the last period of the same. His results are:

(*a*) For the stone age:
First epoch, 4900–3900 B.C., or 1,000 years.
Second epoch, 3900–2400 B.C., or 1,500 years.
Third epoch, 2400–1900 B.C., or 500 years.
(*b*) Bronze age, 1900–500 B.C., or 1,400 years.
(*c*) Iron age, 500 B.C.–1905 A.D., or 2,400 years.
Total of 6,800 years.

According to Sophus Müller,[1] only about 4,900 years have elapsed since the beginning of the stone age in Denmark. He places the duration of the first epoch of the stone age at a minimum of 500 instead of 1,000 years, and the beginning of the bronze age at 1200 B.C. instead of 1900 B.C.

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Catalogue of the Fossil Plants of the Glossopteris Flora in the Department of Geology, British Museum (Natural History). By E. A. Newell Arber. London, 1905. Pp. lxxiv + 255; pl. 8; text f. 51.

This book as is indicated by the subtitle is a 'Monograph of the Permo-Carboniferous Floras of India and the Southern Hemisphere,' and as such will prove not only a boon to the paleobotanist, but of inestimable value to the student of phyto-geography and the evolution of floras. It will be welcome to the geological workers interested in the correlation of those perplexing series of strata so widely distributed in the southern hemisphere and should also be in the hands of those interested in Paleozoic glaciation. Locally the work will also have a large economic value in the hands of operators and prospectors for coal in the regions of which it treats. It embodies the first comprehensive treatment of this flora, and contains, not only a critical summary of previous knowledge heretofore widely scattered through an immense number of publications, but also embraces considerable additions to our knowledge.

The oldest assemblage of land-plants sufficiently representative to be called a flora is that which appeared during the Devonian and became highly complex in the later Devonian and Lower Carboniferous time. This flora was a cosmopolitan one and discloses a remarkably uniform character wherever plant-remains have been found in the rocks of these periods, from about latitude 75° north (Ellesmere Land and Bear Island) southward to Australia and Argentina. This flora included representatives of the following orders: Equisetales, Lycopodiales, Sphenophyllales, Filicales, Cordiatales and Cycadofilicales, the latter possibly including seed-bearing forms (Pteridospermæ). In passing upward into the Upper Carboniferous we find three additional orders, the Cycadales, Ginkgoales and Coniferales; none of these however become of real importance until the dawn of the succeeding Mesozoic era. With the Upper Carboniferous, however, the world-wide uniformity of this ancient flora becomes broken and it is separated into sharply defined northern and southern floras each made up of types belonging to the six dominant Paleozoic orders, which present, nevertheless, an entirely different facies in the two regions. The southern flora, found in strata laid down immediately subsequent to widespread glacial deposits (the Talchir boulder bed of India, the Dwyka con-

[1] *Nordische Altertumskunde.*

glomerate of South Africa, the glacial deposits of New South Wales, Queensland and Tasmania, of the Salt range of India and of Brazil) is usually known as the *Glossopteris* flora, so-called by Neumayr because of the extreme abundance of the undivided fronds of this fern-like plant. This flora is assumed to have been more or less completely isolated from the continental mass of the northern hemisphere, and to have flourished over a great southern continent termed by Suess Gondwanaland from the typical *Glossopteris*-bearing rocks of the lower part of the lacustrine Gondwana system of India.

This *Glossopteris* flora may be roughly characterized and contrasted with that which flourished to the north of it, in the following manner. In the order Equisetales the *Calamites,* which are dominant types in the north are replaced by *Schizoneura* and *Phyllotheca,* the latter dominant and widespread with several species, the former with but few species and not becoming a dominant type until the Mesozoic when it had spread beyond the confines of Gondwanaland. In the order Sphenophyllales one restricted species in India and possibly in South Africa is the sole representative of this common northern type and evidently is an introduced form. The Filicales are characterized by the genera *Glossopteris, Gangamopteris, Neuropteridium* and *Palæovittaria, Gangamopteris* appearing somewhat earlier and replacing the former in Victoria and Brazil.

Neuropteridium is very wide ranging but not abundant, while *Glossopteris* is exceedingly diversified, widespread, and very abundant numerically. The genus *Tæniopteris,* while present, is not a characteristic or an abundant type until the succeeding Mesozoic era, while the various other fern genera which are present are too indefinite or rare to be important elements in a discussion of the flora as a whole. In the order Lycopodiales the southern forms are similar to the northern (*Lepidodendron, Bothrodendron, Lepidophloios, Sigillaria*) and represent a southward migration to South Africa and South America over land connections in those general regions. In the order Cordaitales the important northern type *Cordaites* is replaced by the genus *Nœggerathiopsis* which is widely distributed throughout Gondwanaland, reaching Tonquin and China in the Mesozoic. The Cycadales are few and of a doubtful nature. The Ginkgoales are represented by the indefinite forms referred to *Rhipidopsis* and *Psygmophyllum,* and are also harbingers of the Mesozoic flora. The Coniferales are also few in number and somewhat indefinite in character and may be neglected here. We thus see that of the six dominant Paleozoic orders the Lycopodiales and Sphenophyllales were represented in the Glossopteris flora by only a few migrants. The essentially post-Paleozoic Cycadales, Ginkgoales and Coniferales are alike for both the northern and southern floras, and the chief contrasts are furnished by the fern-like plants and the members of the Equisetales. Land connections evidently became accessible toward the close of the period for we find *Glossopteris* and *Phyllotheca* in the Permian of northern Russia, while other survivors are found in the Mesozoic of Germany, Sweden, China, etc.

The precise age of the *Glossopteris* flora has been a warmly disputed question for over half a century, such eminent paleobotanists as de Zigno, Schimper and Feistmantel claiming it to be Mesozoic (Jurassic), while Clarke, the Oldhams and the Blanfords held that it was of Paleozoic age. Arber's conclusion, one largely accepted in recent years, is that the *Glossopteris*-bearing rocks are homotaxial with those of the Upper Carboniferous and Permian of America and Europe. It was found impossible to distinguish between the Carboniferous and Permian periods so that the epoch as a whole must continue to bear the somewhat indefinite title of Permo-Carboniferous. While it appears that isolation alone could not have produced the remarkable character of the *Glossopteris* flora, Arber refrains from discussing climatic conditions beyond the statement that the widespread glaciation immediately antecedent to the deposition of the earlier *Glossopteris*-bearing sediments probably had a marked influence in this connection. It would have added

greatly to the interest of the work to have had a discussion of the climatic conditions based on the paleobotanical and other evidence at the command of the author.

While largely a matter of speculation, it would seem that the question of an Antarctic continent rather than the more restricted Gondwanaland in lower latitudes might have been considered with profit, although such a discussion might possibly be out of place in a publication of this sort, at any rate, its omission can in no wise be urged as a criticism of this admirable piece of work.

In the matter of nomenclature Arber is cautious, one might say conservative, throughout, and scant space is devoted to those species founded upon fragmentary and indefinite impressions. This 'lumping' process does not seem to be a defect, as many believe it to be in some of the preceding volumes of the British Museum Catalogues, although undoubtedly the actual abundance of species in nature is thereby probably underestimated.

In the genus *Glossopteris* the great variability of size and shape in the same species is emphasized, attention being called to the danger of founding species upon such characters as the thickness or persistence of the midrib, the obtuse or acute apex, or differences in the angles of divergence of the secondary veins, all characters more or less closely correlated with the size and shape of variable fronds. The only characters which seem reasonably safe in systematic work, until internal structures are known, are the average shape of the areoles and the openness or closeness of the secondary veins. In a revision from this viewpoint, confessedly artificial, the author reduces the large number of species of Feistmantel and others, to thirteen forms.

Considerable space is devoted to what little is known of the fructifications of this genus, and many other items of botanical interest are found throughout the work. Mr. Arber is to be congratulated for the way in which he has completed a difficult task, and paleobotanists owe him a debt of gratitude for the thorough way in which he has organized and systematized the literature and nomenclature of this most interesting and heretofore least known flora. Some ninety-two species besides a number of indefinite remains are catalogued. The illustrations are ample and well executed, there being 8 plates and 51 text figures in addition to a map showing the supposed land areas of the Permo-Carboniferous. The systematic portion is preceded by a discussion of the botanical affinities of the flora, its distribution in space, its age and distribution in time, including specific and geologic tables of distribution and correlation, a historical sketch and a history of the collection. The bibliography is complete and the work taken as a whole merits nothing but the warmest praise.

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Chemie der alicyklischen Verbindungen. Von Ossian Aschan, A. o. Professor an der Universität Helsingfors. Braunschweig, Fr. Vieweg und Sohn. 1905. Pp. xlvi + 1164.

The alicyclic or polymethylene compounds, sometimes also called hexahydrobenzene derivatives, have, up to the present time, received rather stepmotherly treatment from text-book writers. Some of the substances have been described in connection with the aliphatic compounds, while others have been placed in the aromatic section. In short, like most other transition forms, their classification was troublesome and, except in so far as they were of use in connecting the two great families of organic compounds, they were kept as much in the background as possible. To some extent this was unavoidable; it is only in more recent years that it has been possible to prepare well-defined, crystalline derivatives, the study of which could lead to valid conclusions regarding the constitution of the parent substances; indeed, the preparation, in a state of purity, of many of the latter is attended often with very great experimental difficulty, and yet a fairly large number of the alicyclic compounds which occur in nature, such as camphor and various terpenes, are of considerable technical importance.

Professor Aschan's book marks the termination of this state of things, and already one of