genus *Lioceras*,[1] but Buckman[2] has made it the type of a new genus, *Polyplectus*. The Museum, then, is fortunate in possessing this type-specimen, for it is not only the type of Zieten's species *Amm. discoides*, but also the type of Buckman's genus *Polyplectus*.

NOTICES OF MEMOIRS.

I.—The Basal (Carboniferous) Conglomerate of Ullswater and its Mode of Origin. By R. D. Oldham, Geological Survey of India.[3]

On the western shore of Ullswater, near its lower end, a good section has recently been exposed of the basal conglomerates variously ascribed to Old Red or lowermost Carboniferous age. This conglomerate has been considered as glacial in its origin, but does not appear to the author to present any true glacial characteristics. It contains angular and subangular blocks of all sizes, which are not scattered indiscriminately, but are arranged with a distinct, though obscure, banding. In the admixture of blocks of all sizes and the absence of rounded boulders, it differs from the known river deposits of temperate climes, and more closely resembles the accumulations of débris which result from cloud-bursts than any other form of deposit which can be observed in the British Isles at the present day. The conglomerate cannot, however, be reasonably attributed to any such local deposits; its true analogue must be looked for in the dry regions of Western and Central Asia, where all rainfall rushes off the bare hills, producing an effect very like that of a cloud-burst in our own climate, and causing a mixed mass of water, silt, and stones to rush down the river channels, which are dry or carrying only a feeble stream in ordinary times. This mass of material is carried out from the hills, and forms a deposit with a gently sloping surface extending for miles into the open country. Carried along in this manner the rock-fragments do not undergo the rounding which they suffer in a more permanent torrent, and are deposited, on the sudden subsidence of the flood, in a mixed mass of fragments of all sizes. The sections exposed along the roadside near the foot of Ullswater not only exhibit a rude trending, due to the action of successive floods, but also show patches of current-bedded, fine-grained, gravelly material, representing the action of the feebler stream which continued after the passage of the flood.

The conclusion drawn is that the conglomerate is a torrential deposit, formed on dry land, near the foot of a range of hills, in a generally dry climate, varied by seasonal or periodical bursts of rain. The red colour of the fine-grained material suggests tropical or sub-tropical conditions, as the formation of red soils is at the present day so much more common in tropical than in temperate regions that it may almost be regarded as a characteristic of a hot climate.

[1] Originally spelt *Leioceras*.
[2] S. S. Buckman: Inf. Oo. Amm. (Mon. Pal. Soc.), pt. iv (1890), p. 214.
[3] Read before the British Association, Section C (Geology), Bradford, Sept., 1900.

II.—The Influence of the Winds upon Climate during Past Epochs: a Meteorological Explanation of some Geological Problems. By F. W. Harmer, F.G.S.[1] (Abstract.)

THIS paper is a summary of a communication the author hopes to make to the Geological Society of London during the present winter, and is in continuation of one read at Dover in 1899, on "The Meteorological Conditions of North-Western Europe during the Pliocene and Glacial Periods."

The irregular distribution of the isotherms in the northern hemisphere is largely due to the direction of the prevalent winds. In regions where these are constantly varying, as, for example, in Great Britain, the climate varies diurnally, one day being often dry or cold and the next rainy or warm. In others, where the wind changes seasonally, one part of the year is rainless and another pluvial. Permanent alterations in climate would equally result were the course of the prevalent winds permanently changed.

The direction of the winds, which must always be more or less parallel to the isobars, depends on the relative position, and on the form and alignment of areas of high and low barometric pressure. The movements of the latter being largely interdependent, any important meteorological disturbance, however caused, may make its influence felt at a considerable distance from the focus of its origin.

The winds blow round areas of high and low pressure; outwards, from the former, and to the north of the Equator, from left to right; and inwards, towards the latter, from right to left. Hence, in the northern hemisphere, southerly winds prevail to the east of a cyclonic centre, and northerly winds to the west of it, the contrast between the temperature of the two areas being usually in proportion to the distance the aerial currents may have travelled from the south and the north respectively. Warm and cold winds must therefore necessarily coexist, causing differences in climate in countries having the same latitude. The winter temperature of Hudson's Bay is, for example, 60° F. colder than that of Great Britain. Similar climatal conditions must have also existed during the Pleistocene epoch.

The continental regions of the northern hemisphere, being at present warmer during summer than the ocean, are cyclonic; in winter they are colder, and consequently anticyclonic. Over the great ice-sheets of the Glacial Period, however, high pressure must have prevailed, more or less, at all seasons, and, generally, the meteorological conditions, including the direction of the prevalent winds, and local variations in climate must then have been widely different from those of our own times. Oceanic winds, with copious rainfall, may have prevailed in regions now arid, and mild winters where they are now excessively severe. Such cases of anomalous climate as those of the pluvial conditions of the Sahara, and of Arabia and Persia, during the Pleistocene era, may be satisfactorily explained by the changes in the relative positions of cyclonic and anticyclonic systems which were caused by the gradual growth and

[1] Read before the British Association, Section C (Geology), Bradford, Sept., 1900.

disappearance of the great ice-sheets, as may be the alternate humidity and desiccation of the great basin of Nevada, the former existence of the mammoth on the shores of the Polar Sea, etc.

It is difficult, however, to restore hypothetically the meteorological conditions of the Pleistocene epoch, on the theory that the maximum glaciation of the eastern and western continents was contemporaneous. At present the influence of the Gulf Stream, and the south-west winds caused by the Icelandic cyclone, carries in winter a comparatively warm climate, and low pressures, northwards into the Arctic Circle, but no permanent ice-sheet could have existed in Great Britain under such circumstances. Cyclones and anticyclones in regions more or less contiguous are, however, necessarily complementary, in order that the vertical circulation of the atmosphere may be maintained. The existence of an enormous polar anticyclone, extending southwards over a great portion of Europe and North America, would have involved also that of a cyclonic system of corresponding importance in the North Atlantic, a region which must have been at all seasons warmer than those covered with ice; but this would have caused south-west winds over Great Britain, and have prevented the permanent existence of an ice-sheet in these islands. If Europe and North America had been glaciated at the same time, which for the reasons given, however, seems improbable, the Icelandic cyclone, which now lies (statistically) in winter near to the south-east coast of Greenland, would have been forced to the south; but the further south it went the warmer would have been the southerly winds which blew east of its centre towards Great Britain and Western Europe. Conditions similar to those which may have prevailed during the maximum glaciation of North America occurred during the early part of 1899—for information as to which the author desires to acknowledge his indebtedness to Mr. W. N. Shaw, F.R.S., of the Meteorological Office. At that time a great low-pressure system, which sometimes extended from Europe to America, and from Iceland to the Canary Islands, occupied the North Atlantic. Vast volumes of cold air from the Arctic regions were consequently poured over North America, while Western Europe was flooded by warm aerial currents from the sub-tropical zone. At the beginning of February temperatures of from —40° F. to —60° F. were commonly registered in different parts of North America; at the same time the thermometer rose in London to 66° F., in Liége to 70° F., and in Davos, more than 5,000 feet above the sea, to 62° F., the average maximum for that month at the latter place being 38° F. For some weeks storms of exceptional violence occurred almost daily in the Atlantic. These coincident phenomena are directly traceable to the same cause.

No meteorological difficulties arise if we adopt the hypothesis that glacial and interglacial periods alternated in the eastern and western continents. If the ice-cap extended from Greenland to Scandinavia, the North Atlantic cyclone would have been forced to the south-west, towards the American coast, producing warm south-east winds over Labrador; if, on the contrary, it stretched from Greenland to North

America, the cyclone would have been driven in the direction of Europe, causing mild weather in the latter, as in the case just given.

Such a view affords a simpler explanation of the geological facts than those usually adopted. Instead of supposing that the climatic changes of the Great Ice Age, several times recurrent at intervals of a few thousand years only, were due to astronomical causes, it is here suggested that the climate of the Pleistocene epoch being uniformly colder than that of our own era, conditions of comparative warmth or cold may have been local, as they now are, affecting the great continental areas at different periods.

REVIEWS.

I.—Studies in Fossil Botany. By Dukinfield Henry Scott, M.A., Ph.D., F.R.S., F.G.S., Honorary Keeper of the Jodrell Laboratory, Royal Gardens, Kew. pp. xiii, 553, with 151 illustrations. (London: A. & C. Black, 1900.)

AS the title of Dr. Scott's work implies, "Studies in Fossil Botany" is not a 'textbook' in the ordinary acceptation of the term, giving a systematic course of the entire range of fossil plants, but contains thirteen lectures devoted to the microscopical structure, morphology, and affinities of Carboniferous plants, and one on the Mesozoic Gymnosperms. The groups studied are not chosen at random, but follow each other in natural sequence.

Lectures i–iii are devoted to the Equisetales. The *Calamites* are first described, and here, as in the subsequent groups, a description of the external characters of the group is given. These descriptions, however, take a subordinate place to the description of the internal organization of the plants, which forms the main subject of the lectures. The development of the young Calamite is traced through its early stages, and the different structures which go to make up the complete plant are described in detail. One of the important results of Dr. Scott's examination of the *Calamites* is to prove that the carinal canals of *Equisetum* and *Calamites* are homologous, both resulting from the rupture of the primary wood. After the description of *Arthropitys*, the common English form of Calamite, the two other types of Calamite stem structure, *Arthrodendron* and *Calamodendron*, are considered. The Calamite fructifications, *Calamostachys*, *Palæostachya*, and *Cingularia*, are then dealt with and their morphology discussed; then follow notes on *Archæocalamites* and *Macrostachya*.

In Lecture iv the *Sphenophyllales* are considered. In this group are placed the two genera *Sphenophyllum* and *Cheirostrobus*. This is a specially interesting chapter, dealing with types of plant structure which disappeared with Carboniferous times. Fortunately, the structure of stems, roots, leaves, and fructification of *Sphenophyllum* is known. The two British species showing structure—*S. plurifoliatum*, from the Lower Coal-measures, and *S. insigne*, from the Calciferous Sandstone series—are fully described. *Sphenophyllum*