Missouri river, and continued in the Missourian series along the same stream north from the city. Or, a direction taken southeast of Kansas City is equally advantageous, besides passing through the Clinton district, and reaching into the old gorges in the Mississippian series which are exposed on the flanks of the Ozarks. Work along these lines, both in the floral and faunal fields were begun by the Missouri Geological Survey in connection with the detailed stratigraphical cross-sections, and much valuable material obtained, but the efforts had to be abandoned before the data were complete.

The exposures along the Des Moines and Raccoon rivers, in central Iowa, afford another excellent field for making up a standard paleobotanic section. Plant remains occur in many localities and at numerous horizons. Some exquisite things have been observed. Van Meter affords beautiful ternately divided fern fronds over a yard across. Mud Creek, below the city of Des Moines, furnishes, in profusion, plant-bearing nodules similar to Mazon Creek, in Illinois. Ford supplies structural specimens, showing the wood cells and their workings as perfectly as if they were taken from the living plant. Knoxville has extensive plant beds and the bluffs of the streams in Marion county often have tons of shale-slabs with plants in sight at one time. At one time the Iowa Geological Survey began to get material of this kind together for a report on the coal floras of the State supplementary to the reports on coal deposits. But since the appearance of the first volume of the latter nothing farther seems to have been done regarding the plants.

The main consideration, however, is the fact that the Trans-Mississippian coal field presents for the study of fossil plants a wealth of material unrivalled in the whole country. If standard paleobotanic sections of the region are lacking, it is certainly not because the fossil botanist lacks the material and opportunity to construct them.

Charles R. Keyes.

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*ON THE ZOO-GEOGRAPHICAL RELATIONS OF AFRICA.**

The speaker prefaced his communication by remarking that he had nothing absolutely new to bring forward, but that, inasmuch as some views which seemed to be contrary to evidence had been urged very recently, a presentation of the conflicting evidence was timely, if not necessary. The views in question were broached in 'A Geographical History of Mammals,' by Mr. R. Lydekker, and the address of the retiring president of the New York Academy of Sciences (Professor H. F. Osborn) published last week in Science (April 13th).

Beaumont's apologue of the shield has its counterpart for the fauna of Africa. It has two sides facing in opposite directions, and it cannot be understood without taking both into consideration. The proposition to combine Africa with Asia, Europe and North America into a realm contrasted with South America and Australia (or even to combine again Africa and India against the others) may apparently be justified if we look only to the present mammalian fauna, but if we revert to the past and consider other classes, we must be led to different conclusions.

The fishes are by far the most instructive in their teaching. Very recent discoveries recorded by Mr. Boulenger add force to their testimony. Those animals represent two very distinct assemblages. On the one side, we have Cyprinids of genera occurring also in India or very closely related to such genera. On the other side, we see numerous species belonging to families having no representatives in India or elsewhere than in tropical America. Such are the Cichlids,

* A communication to the National Academy of Sciences made April 18, 1900, by Dr. Theodore Gill.

the Characinids and the Lepidosirenids, which are the most prominent constituents of the African fauna. These families are also equally characteristic of tropical America, but the representatives of the two continents belong to different genera.

The deduction seems to be inevitable that the main element of the piscine fauna was derived from the same source as that of America. The fact that generic differentiation has supervened to such an extent suggests, if it does not prove, that the time that has elapsed since the derivation of the respective faunas is great. Equally inevitable appears to be the fact that the cyprinoid element has been derived from an Asiatic source, and the slight differentiations indicate that the introduction of that element has been comparatively recent.

If we now examine the piscine fauna of Madagascar we find that one of the most characteristic African genera (*Tilapia*) is developed in that island and that there is nothing in that fauna to contradict the evidence of that genus—that it has been derived from Africa or the same main source as the African species.

These views are identical with those promulgated a quarter century ago (in 1875) in the *Annals and Magazine of Natural History*, and then Africa and South America were associated together with Australia in a hemisphere called EOGÆA contrasting with another named CÆNOGÆA, comprising North America, Eurasia and India. The accumulating testimony of the succeeding years has added to the cogency of the argument.

If we now look at the mammalian fauna with the light thus reflected, we may appreciate facts of an analogous nature, but more obscured or complicated by recent interchanges of faunal constituents.

On the one hand are numerous and conspicuous mammalian types congeneric or closely related to Eurasian or Indian forms. On the other hand are many smaller and less obtrusive mammals peculiar to the continent and without any near relatives elsewhere in the present geological epoch.

It has been wisely said that "the final test of a scheme of zoological distribution must be the paleontological test." But the paleontology of Africa has not yet yielded the test. The evidence of paleontology, so far as it goes, points to the origin or development of most of the conspicuous animals of Africa elsewhere than on the continent. It is true that Africa has been declared to be especially the 'center of adaptive radiation during the Tertiary period' of the Proboscideans, as well as of the Hyracoideans. The evidence, for this claim, however, is only negative. At least, so far as the printed record goes, no early remains of Proboscideans or Hyracoideans have been found in Africa, and their former existence there apparently has been assumed because their remains have not been found in better explored lands. The assumption may be right, but it must not be forgotten that it is a pure assumption. Madagascar, however, can not be assumed with strict propriety to be the 'chief centre of adaptive radiation' of all Lemuroideans, inasmuch as that order was formerly widespread, and the great island is rather the last stronghold of the restricted group.

If, as Professor Osborn well urges, it "*is our problem to connect living distribution with distribution in past time and to propose a system which will be in harmony with both sets of facts*," with the facts of distribution of the fishes and even that of mammals in view, the association of the so-called Arctogæan realms is illogical and falsifies the record. Whatever facts a classification may be intended to embody, the African fauna must be isolated. If we wish to express, in our terminology, a former condition of affairs, Eogæa is a term adapted to do so.