Hangman Creek (Latah Cr.) in the southwest part of the city deposits are five or six hundred feet deep, the valley having been filled (as, presumably, was also the valley of Spokane River). As no evidence was found of the glacier having crossed the Spokane River to the east of the city limits and as what appeared to be a marginal moraine was found on the south side of the valley at the southeast corner of the corporation boundary (Pantops) it seemed that the valley of the Spokane must have been completely dammed, impounding the waters of the entire Columbia drainage basin. It was believed that such a volume of water even in a brief time must have cut an outlet which would be readily found. Such was found to be the case. In the gap between Mica Peak and Moran Peak, at the village of Mica, on the O. W. R. & N. Railway, twelve miles southeast of Spokane, at an elevation of about 2,460 feet, two outlets may be easily seen in the field or by examination of the topographic sheet of Spokane Quadrangle of the U. S. Geological map. These two streams join California Creek a short distance south of Mica and follow it to Hangman Creek (Latah Cr.). Apparently Hangman Creek was obstructed here also for the stream followed up Hangman Creek (Oakesdale Quadrangle) until it reached what is now the low land between Hangman Creek and the head of North Pine Creek, where it cut a channel some 200 feet in depth in the Palouse soil of that region, reaching and scouring the basalt beneath, thus opening an outlet to the southwest.

This glaciation was followed by a period when stream erosion cleared the valleys of Spokane River and Hangman Creek and perhaps eroded Spokane Valley almost 200 feet below the present floor (left at the time of the Wisconsin period of glaciation) as shown by the depth of Lake Cœur d'Alene and other lakes which occupy side branches of Spokane Valley. There is also some evidence collected of a glacier having almost reached Spokane from the north by way of the valley of the Little Spokane River. As this is about 400 feet lower than the glaciation on the "prairies" and extends some twenty miles south of what seems to be the terminal moraine of the Wisconsin period (the Wisconsin glaciation reaching Spokane came from the east), it will be seen that we have evidence of three periods of glaciation here. The earliest of these is responsible for "Lake Spokane"[1] and its Mica outlet by way of California, Hangman and North Pine Creeks.

It will be seen from this that a long period has elapsed since the cutting of this great trench through this soil and as yet the æolion deposits have not covered the bare rocks of its floor, though for eight miles between North Pine Creek and Hangman Creek there is no stream sufficient to account for removal of deposits.

(Mr. J. T. Pardee of the U. S. Geological Survey spent six weeks of May and June of this year making a careful study of glaciation and related subjects in northeast Washington and has secured data for what promises to be the most interesting of all recent reports on this subject. The appearance of his report is awaited with great interest. The writer is collecting further material on the shore line of L. Spokane and on the glaciation in Little Spokane Valley.)

THOMAS LARGE
THE LEWIS AND CLARK HIGH SCHOOL,
SPOKANE, WASHINGTON

A SUGGESTION TO ZOOGEOGRAPHERS

Ranges of animals are most easily defined in terms of political divisions, cities near the limit of range, and such readily determinable points. This eminently practical method will doubtless always be used.

But ordinarily zoogeographers have not been content to use only this method, which, from its nature, explains nothing, and questions nothing.

There has been a constant search for some sort of scheme whereby ranges of animals might be reduced to a common denominator. Various schemes of this kind are in use at present and hereinafter shall be commented upon.

[1] The name "Lake Spokane" was given by the writer in a paper on "Glaciation and Vulcanism in the Spokane Region" read on November 3, 1921, before the Columbia Section of the American Institute of Mining and Metallurgical Engineers.

By far the most generally used of these philosophical methods is that of Realms, Regions and Zones. These are all based on the idea that large numbers of species have the same range, and that by picking out some of the conspicuous forms and mapping their ranges one has *ipso facto* a set of regions, to which other ranges may be referred, and with which other ranges should agree.

This is, in some degree, true, but in nearly every case in which the ranges of any two species agree, the agreement is due to the geographic factors and not to the zoologic factors.

It is obvious that the zoogeographical realms are nothing save and except the great land masses with lines drawn to correspond to the physiographic barriers. There is a great philosophical difference between such terms as Holarctic Fauna and Holarctic Region. In the first case we speak of zoological matters in terms of zoology, in the second of geographical matters in terms of mythology.

The Palearctic fauna is an aggregate of species and may invade (in fact *has* invaded) Australia without forfeiting its name.

It occupies, in the main, territory distinct from that of any other fauna, and this by virtue of the Sahara and the Himalaya, but in eastern China there is a broad area where Palearctic and Oriental faunas intermingle and where no line can be drawn which would delimit the range of more than a few species.

In Malaysia, Oriental and Australian faunas overlap in the same way. Van Kampen ("The Zoogeography of the East Indian Archipelago," *Amer. Nat.*, XLV, 1911, p. 537-560) has shown that Wallace's famous line is as mythical as the Jack of Diamonds.

All lines of this sort apply primarily to the animal on whose range they are based (and theoretically should be shifted when the range is extended); secondarily to its parasites, commensals, prey, etc.; and thirdly to animals of very similar constitution, origin, or habits.

Where zonal lines coincide with physiographic barriers there is a noticeable change in fauna within a few miles, where there is no barrier there is a broad region wherein each species is a law unto itself.

In no case can the boundary of a faunal zone, as such, be *seen*.

As, in cases where the zonal lines really mean a sudden change in fauna, there is also present a sharp change in topography, and as this topographical change can be *seen* with the greatest ease (and as, in cases where the zonal lines are based on ranges of a few species, and do not indicate a sudden change in fauna, there is no sharp change in topography), it seems high time to cease disputing about zones and to use terms which have some meaning.

The zones are frequently described as being based on temperature and the lines as corresponding to isothermal lines. Apart from the objection that no one can *see* an isothermal line, the temperature measurements for the zones are not the bases on which these areas are delimited, but are merely the temperatures for areas previously delimited by other means.

Once established the zones have persisted in spite of the extensions of the ranges of many animals on which the zones were originally based, and it is a question whether the range of any one species corresponds with the lines drawn on faunal zone maps.

A second method is the use of "major environments" and "minor environments," which was put forward with considerable diffidence in Shull, Larue and Ruthven, "Principles of Animal Biology," 1920.

These are essentially plant formations or forest areas. In some ways they are more serviceable than zones as plant formations can be *seen*. Also plants are somewhat more interdependent than animals and hence the ranges of more plants might reasonably be expected to coincide. Furthermore, plant formations play a large part in providing animal environment, as forest, prairie, etc., a part recognized in the term "major environment."

But, after all, the same objection holds in this case as in the case of the zones. Where there is a sharp change in plant formation there is usually a sharp change in topography or in soil conditions. Without such change there is no marked change in plant communities.

There is certainly an inherent absurdity in

defining the range of animals whose range one knows, in terms of the ranges of plants and animals whose range one does not know.

Lutz' method of "Geographic Average" (1921, *Amer. Mus. Novitates,* 5) involves considerable calculation, which brings to light with great effort the astounding information that the "mid-range" of a northern species is north of the "mid-range" of a southern species.

He voices considerable discontent with the zones as being indefinite and indistinct. Whereupon he proceeds to define anew the undefinable and to redistinguish the indistinguishable.

Inasmuch as all sharp changes in fauna are dependent on similarly marked changes in topography, it would seem reasonable to adopt physiographic regions, instead of zones, "major environments," and "geographic averages."

For the United States this has been made remarkably easy by the publication of "Physiographic Divisions of the United States," by Nevin S. Fenneman, *Ann. Ass. Amer. Geog.,* VI, 1917, which is the result of long continued work on the part of a committee of the association.

The lines of these divisions in many cases agree with the zones and with the plant formations. This is to be expected for the ranges of many animals should logically stop at a physiographic break, or at a line of sudden change in temperature or moisture, and the former usually carries with it the two latter.

Furthermore the use of these physiographic regions clears the way for intelligent association of animal and plant ranges with the geology and soil conditions, and brings to light routes of dispersal.

For instance, this system makes clear the presence of the Connecticut valley and the Hudson-Champlain trough, in which many southern forms extend north, but to draw these on the map as Upper Austral, indicating faunal identity with Piedmont Virginia (also Upper Austral) is sheer falsehood.

The beauty of this method, however, is its ease of application. These regions can be *seen,* their boundaries can be *seen,* and there is seldom any doubt as to which region one is in or from which specimens came.

Of course, all animals do not respect physiographic boundaries, any more than all animals respect the lines drawn on maps to represent faunal zones.

None of our methods of indicating general distribution is perfect. None ever can be. Zoogeographers might well give some consideration to the results of the "new geography," and afford themselves some justification for their title.

EMMETT REID DUNN

SMITH COLLEGE

CLINKERTILL, A NEW METAMORPHIC ROCK

IN view of the interest attached to the study and identification of tillite a note about a rather unusual form of till may be of interest. This occurrence has never been described so far as the writer is aware.

Capping the northern bluffs bordering the Missouri river in portions of sections 16, 17 and 18, Township 154 west, Range 95 north, Williams County, North Dakota, is a typical bowlder-clay. This till lies on the truncated edges of the gently easterly dipping, lignite bearing, Fort Union Beds. In the sections mentioned above a heavy bed of lignite, here known as the Williston bed[1] immediately underlies the drift. Here as elsewhere the Williston bed has burned back from the outcrop baking the overlying till in places to a thickness of 30 feet or 40 feet. The clinkertill so formed varies in color from salmon-pink to dark brown, brick-red being the common color. In selected spots the material is fused to a porous, scoria-like mass but in most part is only slightly indurated by the heat. This baked till so formed resists weathering and removal and forms the capping of steep bluffs and buttes or mesas.

The most common pebbles found in this clinkertill are granite and limestone. The granite pebbles appear to be unaltered by the heat and the limestone pebbles but slightly as they effervesce freely in hydrochloric acid.

L. P. DOVE

NORTH DAKOTA GEOLOGICAL SURVEY

[1] Collier, A. J., "The Nesson Anticline," Bulletin 691 G., U. S. G. S., p. 213.