if possible. That ptarmigan were to be found upon Attu Island I knew from the report of Mr. L. M. Turner, who visited the island in 1880–81, but who appears not to have collected any specimens.

The *Albatross* anchored in Chichagof harbor, Attu Island, on the evening of May 28, and I spent the next day on shore climbing over the snowy mountain slopes in search of the ptarmigan; and the search was rewarded by our securing five fine specimens, four males and one female. A comparison of these with the specimens which I had from Unalaska and Atka indicated that there are some well marked differences, and that the Attu Ptarmigan is worthy of at least sub-specific rank. Upon returning to Washington I turned the specimens over to the U. S. National Museum, where they have been examined by Doctors Ridgway, Stejneger, and Merriam, all of whom pronounce it a new and well-marked variety.

Local variations. By C. H. Eigenmann.

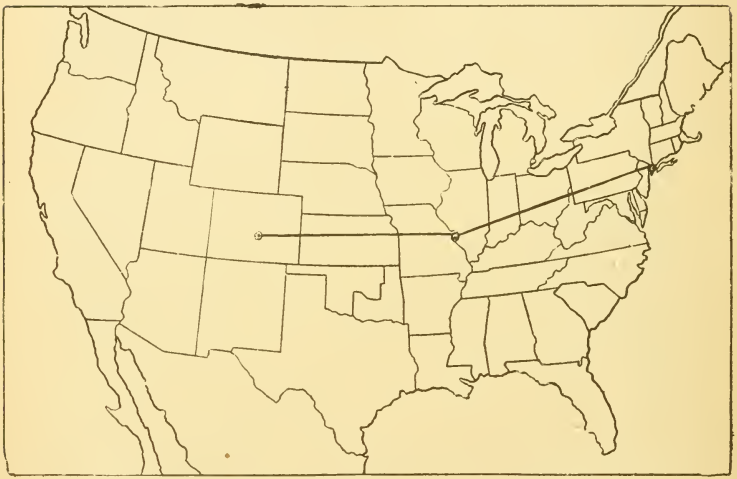
[Abstract.]

A detailed comparison of about 400 specimens of *Leuciscus* from the Columbia basin and the Fraser basin showed that each locality has a variety which in the aggregate was different from the varieties of every other locality. The fin rays were found to decrease with the altitude, and in a general way it was noticed that the variation between the specimens of the same species also decreased with the altitude. These facts were demonstrated by diagrams.

Modern geographical distribution of insects in Indiana. By F. M. Webster.

He who studies geographical distribution is, at the very beginning, brought to understand that the area of any one state, or, indeed, any single country, is far too limited in which to work out his problem, as in the majority of cases the influences which make the presence of a species possible lie, largely, outside the boundaries of such state. The entomology of Indiana is only a fragment of the world's entomology and must be studied in connection with its closely related factors. You will therefore, I hope, pardon me for beginning my subject at a long distance from home and with elements seeming at first to have little to do with Indiana insects.

There are currents of air in the heavens and currents of water in both the oceans and inland streams, and all these have their influence on insect distribution. The influences of the Gulf stream of the Atlantic are far reaching in their effects, as will be further explained, while the corresponding current, sweeping northward along the coast of eastern Asia and south along the west coast of North America, is at present less important in its effects, owing largely, perhaps, to the Rocky Mountains and the Great American Desert. There also seem to be currents of insect migration. These, three in number, may be designated as follows: The



Map indicating, approximately, the natural divide between the northern and southern insect faunas, east of the Rocky Mountains.

Pacific coast, Northwestern and Southwestern. With the first we at present have little to do, as owing, possibly, to the combined influences of the mountains and desert intervening between us and the area directly influenced by it, we see little of the insect fauna of the Pacific coast. To the influence of the Rocky Mountains I attribute the extension of Alaskan forms southward to New Mexico. Whether, with the barriers withdrawn, these trans Pacific and sub-arctic species would drift eastward, is a problem which will likely only be solved when some gigantic system of irrigation

shall cause these desert wastes to cover themselves with vegetation. The other two have an influence on the insect fauna of Indiana which we can as yet but vaguely understand. In a paper on "Some Insect Immigrants in Ohio," read before the Ohio Academy of Science, and, later, published in "Science," Vol. XXII., pp. 57–59, and from which notice the map is extracted, we indicated the dividing line between these two currents of insect migrations in the following terms:

"There are, seemingly, two what we may term gateways through which the majority of species that have come to us from the east, have made entrance into the state of Ohio, and, later, spread out over the northwest. The first, and apparently the most important one of these, being at the extreme northeastern part, adjoining Lake Erie, and which we might term the north gate, and, second, the valley of the Ohio river, from a point where it begins to form the eastern boundary of the state, southward—perhaps to Wheeling, W. Va. Now, there also appear to be two great national avenues or highways which insect migrations follow; progressing more rapidly along either one or the other, but not equally so along both, and often following only one; the more sub-tropical species, whether American or introduced, taking the southern or what I would call the Great Southwestern route, while the sub-arctic, including, besides American, such species as have come to us from England or Europe north of latitude 45° north, take what I would term the Great Northwestern route. The division between these two great thoroughfares will be indicated, approximately, by a line drawn from New York City, latitude 40° 43′ north, to St. Louis, Missouri, latitude 38° 38′ north, thence to Pueblo, Colorado, latitude 38° 17′ north (about), the line of separation trending northward, east of St. Louis, under the influence of the Gulf Stream and the Great Lakes, chiefly the former. Of course it is not to be understood that this line is direct, as it is doubtless more or less irregular, and, from its very nature, to some extent unstable, nor is it to be supposed to form a radical boundary, as some northern forms gradually work their way south of it, and *vice versa*. Yet it will, I think, be found approximately correct."

From the foregoing it will be clearly observed that Indiana is itself but a single factor in the determination of the nature of its insect fauna, and, while the extent of its area covered by a species may be largely a matter of local influences, these are not by any means important factors in determining the exact locality where such species shall first appear within its

borders. This is quite aptly illustrated by *Phytonomus punctatus*, Fab., and *Hylesinus trifolii* Muel.* These entered Ohio first at the extreme northeast corner of the state, and there seems to have been a later introduction by the southeast gateway, the current of the Ohio river carrying them down and landing a colony of each in southeast Indiana and southwest Ohio, thus completely disarranging what had previously seemed very probable, viz: that both of these species would cross northern Ohio and make their first entrance into the state from the northeast. As it is, they will probably not do so, but work to the north and west, the two invasions (a second will probably occur in the northeast) meeting somewhere north of the center, west or southwest of Ft. Wayne. Strange as it may appear, an invasion of foreign or American species starting from Quebec, New England or New York, makes its way westward to the south of the Great Lakes instead of to the north. Therefore, species entering Indiana from Michigan are of rare occurrence. Indeed, I do not know of a single one whose advance can be with certainty traced to such a course. *Aphodius fossor*, Linn., may perhaps be an exception, as it is known to have worked southward to Massachusetts from Canada. It was next found at Detroit, Michigan, and I have seen specimens collected about Chicago, while Prof. Wickham reports it from Iowa, he having found it in 1887. There are, however, at present no good collectors in northern Ohio, and it might have followed the usual route along to the south of Lake Erie.

Invasions have also swept over the state from the west, though not many of these are recorded. *Doryphora 10-lineata*, Say, an American species, will amply illustrate the fact of there being a current of insect migration from west to east, as well as one taking the reverse course.

For anything we can now see, this system of currents and counter currents may have thus been going on for ages, and it is fruitless to attempt

* NOTE.—Since the above was written, I learn that this species has been reported from northeast Iowa by Mr. Wallace, of Des Moines. Investigation, however, develops the fact that this report is based on an injury to clover, supposed to have been done by this beetle. There is no evidence showing that it has been observed in Iowa. Mr. E. A. Schwarz, of Washington, reports it from Detroit, Michigan, and the report is doubtless correct; therefore, it may now occur in extreme northeast Indiana, in accordance with our previous anticipations. I wish also to call attention to the fact that this insect, in European catalogues, is placed in the genus *Hylastes*, and, so far as known to the writer, has never been considered as belonging elsewhere. If it belongs to this genus in Europe, it should in the United States, since no striking anatomical changes would follow its transportation from that country to this. If our genera are not in conformity with those of the same name in other countries, then why use a preoccupied name? The idea that this species shall be a *Hylesinus* in America and a *Hylastes* in Europe, is sheer nonsense and should be corrected, either in one country or the other.

to show how many of our now thoroughly established species may have been brought to the state in this manner. This much for the insect current of migration that has passed over our great northwestern route.

In regard to the southwestern route, while it may be said to cover a smaller area of the State, it has, probably, brought a less number of species of foreign origin, while of American species, it may have supplied the state fauna with nearly an equal number. Any one who will take the pains to look into the matter will be surprised at the number of southern species that are hovering about in the vicinity of our dividing line, which marks either their approximate northern limit of occurrence, or else their northern limit of normal abundance. Among the Lepidoptera, *Agraulis vanillæ*, Linn., is a good illustration, as it covers almost exactly the southern area and is found in Indiana only in one of the extreme southern counties. *Argynnis diana*, Cram., is probably another example. On the other hand, *Papilio ajax*, Linn., and *P. cresphontes*, Cram., both southern species, have pushed over and far beyond our line of demarkation. Indeed, it seems probable that the former has reached farther north in western New York than it has along the Atlantic. The same might be said of one of the Orthoptera, *Acridium americanum*, Scudd. I have observed this rarely in southern DeKalb county, northern Illinois, and quite abundantly in southern Illinois, and know it to occur sometimes in exceedingly great numbers in southeast Indiana. It pushes far north of our dividing line, but is abundant only near or to the south of it. The following from "Field and Forest," Vol. II., p. 145, Feb., 1877, will prove interesting in this connection:

"Acridium americanum.—Two correspondents, of the Department of Agriculture, writing from Vevay, Indiana, about the middle of last November, reported the visitation in that place of an immense cloud of grasshoppers that literally covered the streets of the town. One of the gentlemen observed, about 5 P. M., dense cumulo stratus clouds in the southwest, gradually overspreading the sky; at 6 o'clock the wind had risen to moderate gusts, and within half an hour a rattling noise was heard against the windows, like that of light hail. On opening the doors, grasshoppers entered in immense numbers, covering the floors, furniture, clothing, &c. The shower continued till 8 o'clock P. M., when the ground was thickly covered, and the boys began to burn them, shoveling them into bonfires. The specimen sent shows the insect to have been the *Acridium americanum*, one of our largest American grasshoppers."

Stagmomantis carolina, Burm., is an inhabitant of southern Indiana, and breeds in the extreme southern portion, and, at least, as far north as Jefferson county. I learn that a female was captured in Indianapolis last year. The line given, however, marks its northern limit of usual occurrence. In Coleoptera, *Dynastes tityus*, Linn., is a good example. It is a southern species, occurring from Central America northeast to southern New York. Its northern limit in Indiana is near the line given on the accompanying map. It breeds in the vicinity of Bloomington, and I have seen a specimen taken at Columbus. *Tetracha virginica*, Linn., whose distribution Schaupp gives as "Texas, Louisiana, Florida, Nebraska and Pennsylvania," I have taken at LaFayette.

In Hemiptera, *Murgantia histrionica*, Hahan, whose southern home is Gautemala and Mexico, began its northward march from Texas about 1866, and has now reached northern New Jersey on the east, occurring in southern Ohio, where it appeared about 1889. It has for quite a number of years been observed in southern Illinois, but seems not to have appeared in Indiana until 1890, when it was observed in Perry county. It also occurs commonly over the southern half of Missouri, and, in fact, covering the whole area south of our dividing line, and, as shown, crowding closely up to it in Ohio, Indiana and Illinois, though it is not likely to extend far beyond this in either of these states. Its slow progress and scanty numbers show it to have nearly reached its northern limit. There are two other members of this order of whose local distribution I wish to speak, the origin of both being enveloped in an obscurity altogether too dense to offer any hope of our ever being able to solve the mysteries of their diffusion. I refer to the Chinch bug, *Blissus leucopterus*, Say, and *Cicada septendecim*, Linn.

The Chinch bug was described by Say from a specimen from the east shore of Virginia, though it is now known to have at that time occurred in destructive numbers in Illinois, and at no great distance from New Harmony, Indiana. In fact, Illinois seems to have been the central point of its greatest abundance—the storm center, so to speak. In Indiana, its destructive area may be approximately included by a line drawn from the northwest corner, near Chicago, to New Albany, and its area of occurrence in noticeable numbers by a line drawn from the same point to Ft. Wayne and the eastern border of Ohio. North of this line, especially in the northern row of counties, the insect can only be found by close collecting. I myself spent a half a day in LaGrange county during a season of great

abundance elsewhere, and found but a single specimen, and this of the short-winged form, which occurs also in New York, being variety (*e*) of Fitch. I have spent a great deal of time and investigation in trying to unravel the mystery of this distribution, but can now give no reason for the almost total absence of the species in the northeastern portion of the state, while they are overabundant in the opposite direction.

While located in Indiana, an opportunity was offered me to study the distribution of three broods of *Cicada septendecim*, Linn., very carefully. These were Brood XXII., 1885; Brood V., 1888; Brood VIII., 1889. The first of these covered the whole area of the state except a narrow strip of country around the southern extremity of Lake Michigan, the outlines being approximately described by a line commencing at the northern boundary of the state, nearly or quite due north of the city of LaPorte, and extending nearly south-southwest, running a short distance east of Westville, on the L., N. A. & C. R. R., and crossing this railway near Wanatah; then sweeping southwest to the western boundary of the state. This brood probably occupied the territory along the Kankakee river, and extending a short distance northward into Lake and Porter counties.

Brood V., 1888, so far as I have been able to learn, covered almost exactly the area not visited by Brood XXII., and was not observed elsewhere in the state.

Brood VIII., I have definitely recorded from the counties of Brown, Clark, Crawford, Daviess, Dearborn, Floyd, Gibson, Harrison, Johnson, Knox, Lawrence, Monroe, Morgan, Orange, Scott, Tippecanoe, Warwick and Washington. In Harrison county, only, were the insects abundant, and in Tippecanoe county the invasion was only known from a single female captured by the young sons of Dr. E. Test. Broods XXII. and V. are both strong ones, while Brood VIII. is apparently very weak, and, owing to the clearing up of the forests and the attacks of the English sparrow, it will not be surprising if it becomes nearly or quite extinct in Indiana during the next century.

Of the Diptera very little is really known. I am quite sure the two species of Simulium, *S. pecuarium*, Riley, and *S. meridionale*, Riley, both inhabit the southwestern portion of the state. How far northward they may occur I am not able to say. The species found in Franklin county I am sure is different, but it may not be a northern form.

I have thus gone over the subject in a general way, without going into a detailed account of a greater number of species than necessary to illus-

trate my points. To have done so would have required a greater knowledge of local distribution of species than we now possess. What is at present especially needed is intelligent, continuous, persistent local collecting, such as is being done by Mr. Evans, of Evansville, Profs. Blatchley, of Terre Haute, and W. P. Shannon, of Greensburg, and Judge McBride and sons, of Elkhart. It is only by long acquaintance with a locality that we become familiar with its fluctuating insect fauna—species that do not occur every year, and when they do appear are present only in scant numbers and over a limited area.

A careful study of species, other than those here given, may throw much light on the problem of general geographical distribution, and our dividing line is supposed to be correct in a general way, as, of course, there can be no such thing as an exact or continuous line of demarkation. This will of necessity be more or less irregular. Again, a species spreads over an area particularly adapted for its occupancy. But, no sooner is this done than the individuals along the frontier begin to adapt themselves to an environment but slightly unfavorable, and, as their adaptation changes, so do they slowly advance outward from the territory originally occupied. A series of to them favorable seasons might occasion the occupation of a wide margin of adjoining country, while a series of unfavorable seasons might sweep this tide of advance back nearly or quite to the place of its origin. But, as the receding tide of the ocean leaves many pools of water in the depressions of rock, so will there be left, in especially favorable nooks, a few of the insects which will retain their hold and form small, local colonies, of perhaps not more than a few individuals, and the offspring of these will meet the investigator long distances from the real habitat of the species. There is scarcely a collector who does not know of one or more small, secluded areas, in his neighborhood, that are rich in varieties, and which he seldom visits without satisfaction, and frequently he is astonished at his success. How long this ebb and flow has been going on, and how many species have been brought to us in this way, are problems we are yet unable to solve. Therefore, these facts have been brought together, and are here presented, not as a finished, or, indeed, as an advanced study, but rather as a primary outline, to be revised and modified as our knowledge of the geographical distribution of our species shall be enlarged by additional study and research.