ants in having the power of feeding by regurgitation and of forming polydomous colonies. These conditions merely serve to link the Ponerinæ more closely with the Myrmicinæ, Camponotinæ and Dolichoderinæ. Dr. Cook destroys the value of his own observations by continually using them in support of his perverse speculations. I can see no reason, therefore, for revising my opinion in regard to the taxonomic and economic status of the kelep as expressed in two previous papers in this periodical.[8] Apparently the harder Dr. Cook works to confer exceptional attributes on the kelep, the greater becomes its similarity to other ants, especially to the relatively unplastic Ponerinæ, and hence the less promising it becomes as a subject for agricultural experiment.

The sole result, which, in my opinion, we had a right to look forward to, from all this Corybantic enthusiasm over the introduction of an exotic ant into the United States, was not the protection of the cotton plant from the attacks of the boll weevil, but the production by some well-trained entomologist of a carefully written and illustrated memoir on the structure and habits of a ponerine ant. Under the circumstances and with the funds and facilities at its disposal, this lay well within the competence of the Bureau of Entomology, and may, in fact, be actually under way in the promised report. But assuredly Dr. Howard is not to be congratulated on the kelep articles hitherto published under the auspices of his bureau. We are accustomed to receiving much better work from that quarter.

William Morton Wheeler.

ISOLATION AND THE ORIGIN OF SPECIES.

President Jordan's paper 'The Origin of Species through Isolation'[1] has been read by me with much interest. The following paragraph may be quoted as the caption under which he writes:

> In nature a closely related distinct species is not often found quite side by side with the old. It is simply next to it, geographically or geologically speaking, and the degree of distinction almost always bears a relation to the importance or the permanence of the barrier separating the supposed new stock from the parent stock.

It appears to me, however, that the case as stated by him can find scant support of the botanists, to whom it is, I think, easier to find exceptions to the rule, than facts in support of it. The question is, of course, a very complicated one and all who embark on a discussion would fain sound the '*obligato*' of Leonard Stejneger, 'so far as I know.' A few instances drawn at random will suffice at least to throw a reasonable but large doubt upon the factor of isolation and the extent of its effects, as stated by President Jordan, at least so far as plants are concerned, and this doubt should, I believe, obligate us to put the caption cited above into the form of an open question.

Lycopodium complanatum L. and *L. tristachyum* Pursh are two very distinct but closely related species of club-mosses occupying the same range. If we attempt to construct a theory of their origin we are compelled to regard them as genetically related, whatever the mode of origin may have been. These species often grow intermingled in the same habitat, and it was the contrast which they presented under such conditions which forced me to examine them with great care and finally to decide upon their distinction.[2] And if, as has been urged, our eastern North American plant, *L. complanatum,* is not the true European species, the case is strengthened rather than weakened.

In the deserts of the southwest are to be found numerous closely related species of cacti, especially of the genus *Opuntia,* occupying the same habitats and, perhaps, the same ranges. It would be difficult to apply the principle of isolation to these. As an example I may say that there are two distinct but closely related species of the prickly pear type, which I may not, in the present state of their taxonomy, presume to name, distinguishable by their fruits, which are in one species

[8] Science, September 30 and December 2, 1904.

[1] Science, II., 22: 545–562, November 3, 1905.

[2] Lloyd, F. E., 'Two Hitherto Confused Species of *Lycopodium*.' *Bull. Torrey Botan. Club,* **26**: 559–567, November 15, 1899.

globose and dark red, and in the other obconical and yellow and brown, in maturing, respectively. The hybrid character of some individuals must be admitted in theory, but the presence of the two types associated in the same habitat is beyond doubt.

Again, to cite a striking, if sweeping, illustration, it is to be properly appreciated that all the species of the fleshy Euphorbiaceæ are confined to one grand region, and all the analogous species of the Cactaceæ to another. The species composing a genus may not be exactly coextensive, but the ranges of many species may and often do overlap, and are to this extent coincident.

Among the violets, the old species, of Gray's 'Manual,' *Viola palmata,* a few years ago was made to comprehend a number of 'varieties' then so called. These have now been shown to be a number of distinct but closely related species, some of which, at any rate, exist side by side in the same habitats and have the same or similar ranges. The same may be said of the certain yellow, stemmed violets, and of the white violets, *V. lanceolata* and *primulæfolia.*

Two species of *Drosera, rotundifolia* and *longifolia,* are constantly found together and are usually expected to be so found by every collector. Two other species are often associated with them, though not always.

Œnothera biennis and *O. Oakesiana* grow together in the same habitat. So also *Asclepias incarnata* and *pulchra,* two species of the milkweed which are not readily recognized by the tyro, but are yet perfectly distinct, grow constantly associated in the same swamp.

Rhodiola integrifolia is distributed from Colorado to Alaska. In Colorado *R. polygama,* closely related to it, is found with it in the same habitat. The two are not separated by any geographical barrier.

Of the *Potentilla* quite a number of species are very often associated, especially those of the *nivea, gracilis* and *rubicaulis* groups. Three or four of the species may usually be found growing in the same patch of an area not larger than a good-sized room. Of the sedges, many species, often closely related, are to be found in the same bog.

The hammocks of Florida are particularly interesting in this connection because of the great number of species to be found in restricted habitats. Two species of white-flowered *Lantana, odorata* and *involucrata,* are always or nearly always found together, and this applies to the two yellow-flowered kinds, *depressa* and *ovatifolia.* The two live-oaks, *Quercus geminata* and *Virginiana,* are in the same case. *Catopsis nutans* and *Berteroniana* grow intermingled on the same tree, and the same may be said of many other epiphytic species, including Tillandsias, Epidendrons and other orchids. It is worthy of remark that just at the places where the struggle for existence may be presumed to be the most intense between the individuals of the vegetation there also do we find many examples of the same association of closely related species.

Among the ferns, examples are numerous, notably so again in the case of the tropical epiphytic filmy fern, Elaphoglossums and Polypodiums, which grow intermingled, as every one can testify who has examined herbarium specimens which are often composed of two closely related species and therefore not discerned as such by the collector. In Jamaica there are a half-dozen species of tree-ferns which are endemic to the island and are practically always intermingled! Of northern edaphic species *Botrichium obliquum* and *dissectum* are always expected to be found growing together, and the same may be said also of *B. neglectum* and *lanceolatum. Dryopteris Goldieanum,* though more restricted in its choice of habitat than *D. marginale,* is often found with it.

Examples among the mosses and liverworts are abundant. *Orthotrichum Brownii, Ohioense* and *brachytrichum* may not infrequently be found mixed together, and even three other species of this genus may be associated with them, all growing on trees. The rocks support, for example, *Dicranum longifolium* and *viridis,* often components of the same tuft, and thus also *D. fuscescens* and *montanum.* Concerning the liverworts, a citation from Spruce is instructive: "I have a small tuft

gathered by Mr. Stabler on Bowfell which comprises five species of *Marsupella* intermingled in the space of a square inch." Be it remembered that Spruce was a most critical student of these forms.

And, if these are proper examples, what of the numerous species of oaks, willows, thorns, asters, golden-rods and many others which spring up in hosts to challenge our scrutiny? Certainly we should think long before applying the principle advocated by President Jordan to these. And what too, shall we say of the many species of the Siphoneæ, the sea-fans, shaving-brushes and their like which grow in the warmer waters of the tropics, many closely related kinds in restricted and identical localities, a condition quite analogous, I venture to say, to the distribution of the oaks, willows, *et cetera*.

It therefore appears that the general law as stated by President Jordan, 'Given any species in any region, the nearest related species is not likely to be found in the same region nor in a remote region, but in a neighboring district separated from the first by a barrier of some sort,' would be more in harmony with the facts in the case as understood by the botanists if stated in the converse form.

President Jordan further admits that, theoretically, mutations may arise which may hold their own in competition with the parent form, but states that such a condition is virtually unknown.[4] This, however, is far from being the case among the plants. Aside from the many properly designated species in cultivation, we have definite, well-authenticated cases of uncultivated forms which give denial.

In 1886, de Vries found in the fields of Hilversum a plant, *Œnothera brevistylis*, which turned out to be a mutant of *O. Lamarckiana*. Although *O. brevistylis* produces comparatively few seeds compared with the parent form, and has not arisen anew as a mutant since the time of its discovery, it has, nevertheless, been able to maintain itself alongside the parent species in the original habitat up till the present time. *O. brevistylis* may be artificially crossed with the parent form and when this is done the progeny split according to the Mendelian principle, so that, even if this were the means of propagation upon which *O. brevistylis* depends, the race would be maintained.

Without recounting the case of *Capsella Heegeri*, and other well-known instances which are completely authenticated, we may see that it is unwise for us to ignore the probability that the same thing has occurred in nature very many times.

The examples which I have given above are only a few of a thousand which might just as easily be recited and have occurred out of hand to me and to a few of my colleagues whom I have questioned on the matter.

Apropos of the proposition[5] that all the organisms in a region unbroken by barriers will slowly change together in the process of adaptation by nature, I may be permitted to point out that it is again still an open question whether this is the method by which a peculiar flora has attained its apparent uniformity. Curiously enough we find markedly desert types, *e. g., Zyzyphus*, a thorny shrub of the desert, growing chiefly along water courses, and opposite types, as *Verbena ciliata*, which can not be seen to differ from a so-called 'mesophytic' garden weed, ecologically or physiologically, getting along quite well in the habitat of *Cereus giganteus*, the ocotillo (*Fouquieria splendens*) and a lot more specialized enough plants. Similarly we find, for examples, a species of *Opuntia, O. Opuntia*, growing in our eastern states associated together with mesophytes, just as we find many mesophytes growing in arid deserts. Why? The answer to this query involves some answer to the problem of the origin of desert floras, one, however, which has not yet been solved.

F. E. Lloyd.
Teachers College,
Columbia University.

[3] *Rev. Bryologique*, **8**: 104. 1881.
[4] *L. c.*, p. 545.
[5] *L. c.*, p. 547.

The Small Mounds of the United States.

In the two papers on the probable origin of the small mounds in the southern and western parts of the United States, which have ap-