No. 9. — *Catalogue of the Terrestrial Air-breathing Mollusks of North America, with Notes on their Geographical Range.* By W. G. Binney.

In connection with my friend, Mr. Thomas Bland, I have collected many facts relating to the North American Land Shells since the publication of our Monograph.* The following pages give a synopsis of the more important of these, especially such as throw light upon their classification, synonymy, and geographical distribution.

As regards classification, I have followed the arrangement proposed by Mr. Bland and myself in the Annals of the Lyceum of Natural History of New York, Vol. X. p. 158.

As regards synonymy, I have followed our Monograph referred to, except in a very few cases where more ample opportunities of study have caused me to reconsider our decisions. Future study will, no doubt, eliminate as synonymes several species of the present catalogue. I have added the species described since our Monograph was printed. Happily but two synonymes have been added to our list since then, — *Vertigo tridentata* and *Helix ptycophora.*

As regards geographical distribution, it must be borne in mind that the data are very imperfect on which I base my views. Future research will, no doubt, greatly modify them. I have omitted the species of Lower California as belonging to the fauna of Mexico. San Diego is the lowest point from which we have truly Californian species.

PULMONATA GEOPHILA.

OLEACINIDÆ.

Glandina Vanuxemensis, *Lea.*
truncata, *Gmel.*
parallela, *W. G. B.*
Glandina decussata, *Desh.*
bullata, *Gld.*
Texasiana, *Pfr.*

* Land and Freshwater Shells of North America, Part I. Pulmonata Geophila. By W. G. Binney and Thomas Bland, Washington, Smithsonian Institution, 1869.

HELICIDÆ.

(*Vitrininæ.*)

Macrocyclis Vancouverensis, *Lea.*
sportella, *Gld.*
concava, *Say.*
Voyana, *Newc.*
Duranti, *Newc.*
Zonites kopnodes, *W. G. B.*
fuliginosus, *Griff.*
friabilis, *W. G. B.*
caducus, *Pfr.*
lævigatus, *Pfr.*
demissus, *Binn.*
ligerus, *Say.*
intertextus, *Binn.*
subplanus, *Binn.*
inornatus, *Say.*
sculptilis, *Bland.*
Elliotti, *Redf.*
cerinoideus, *Anth.*
cellarius, *Müll.*
Whitneyi, *Newc.*
nitidus, *Müll.*
arboreus, *Say.*
viridulus, *Mke.*
indentatus, *Say.*
limatulus, *Ward.*
minusculus, *Binn.*
Zonites milium, *Morse.*
Binneyanus, *Morse.*
ferreus, *Morse.*
conspectus, *Bland.*
exiguus, *Stimpson.*
chersinellus, *Dall.*
capsella, *Gld.*
fulvus, *Drap.*
Fabricii, *Beck.*
Gundlachi, *Pfr.*

*

gularis, *Say.*
suppressus, *Say.*
lasmodon, *Phillips.*
significans, *Bland.*
internus, *Say.*
multidentatus, *Binn.*
Vitrina limpida, *Gould.*
Angelicæ, *Beck.*
Pfeifferi, *Newc.*
exilis, *Mor.*
Limax maximus, *Lin.*
flavus, *Lin.*
agrestis, *Müll.*
campestris, *Binn.*
Hewstoni, *J. G. Cooper.*

(*Helicinæ.*)

Arion fuscus, *Müll.*
Andersoni, *J. G. Coop.*
foliolatus, *Gld.*
Ariolimax Columbinaus, *Gld.*
Californicus, *J. G. Coop.*
niger, *J. G. Coop.*
Prophysaon Hemphilli, *Bl. & Binn.*
Binneia notabilis, *J. G. Coop.*
Hemphillia glandulosa, *Bl. & Binn.*
Patula solitaria, *Say.*
Patula strigosa, *Gld.*
Hemphilli, *Newc.*
Cooperi, *W. G. B.*
Idahoensis, *Newc.*
Haydeni, *Gabb.*
alternata, *Say.*
Cumberlandiana, *Lea.*
tenuistriata, *Binn.*
perspectiva, *Say.*
striatella, *Anth.*

Patula pauper, *Mor.*
Horni, *Gabb.*
asteriscus, *Morse.*
incrustata, *Pfr.*
vortex, *Pfr.*
Helix lineata, *Say.*

*

labyrinthica, *Say.*
Hubbardi, *Brown.*

*

Yatesii, *J. G. Coop.*

*

auriculata, *Say.*
uvulifera, *Shuttl.*
auriformis, *Bld.*
Postelliana, *Bld.*
espiloca, *Rav.*
avara, *Say.*
ventrosula, *Pfr.*
Hindsi, *Pfr.*
Texasiana, *Moricand.*
triodontoides, *Bld.*
Mooreana, *W. G. Binn.*
tholus, *W. G. Binn.*
hippocrepis, *Pfr.*
fastigans, *L. W. Say.*
Jacksoni, *Bld.*
Troostiana, *Lea.*
Hazardi, *Bld.*
oppilata, *Moricand.*
Dorfeuilliana, *Lea.*
Ariadnæ, *Pfr.*
septemvolva, *Say.*
cereolus, *Muhlf.*
Carpenteriana, *Bld.*
Febigeri, *Bld.*
pustula, *Fer.*
pustuloides, *Bld.*
leporina, *Gld.*
Harfordiana, *J. G. Coop.*

*

Helix polygyrella, *Bld. & J. G. Coop.*

*

spinosa, *Lea.*
labrosa, *Bld.*
Edgariana, *Lea.*
Edvardsi, *Bld.*
barbigera, *Redf.*
stenotrema, *Fer.*
hirsuta, *Say.*
maxillata, *Gld.*
monodon, *Rack.*

*

palliata, *Say.*
obstricta, *Say.*
appressa, *Say.*
inflecta, *Say.*
Rugeli, *Shuttl.*
tridentata, *Say.*
Mullani, *Bld. & J. G. Coop.*
fallax, *Say.*
introferens, *Bld.*
Hopetonensis, *Shuttl.*
vultuosa, *Gld.*
loricata, *Gld.*

*

major, *Binn.*
albolabris, *Say.*
divesta, *Gld.*
multilineata *Say.*
Pennsylvanica, *Green.*
Mitchelliana, *Lea.*
elevata, *Say.*
Clarki, *Lea.*
Christyi, *Bld.*
exoleta, *Binn.*
Wheatleyi, *Bld.*
dentifera, *Binn.*
Roëmeri, *Pfr.*
thyroides, *Say.*
clausa, *Say.*
Columbiana, *Lea.*

Helix germana, *Gld.*
Downieana, *Bld.*
jejuna, *Say.*
devia, *Gld.*
profunda, *Say.*
Sayii, *Binn.*
*
harpa, *Say.*
*
pulchella, *Müll.*
*
hispida, *L.*
rufescens, *Penn.*
*
Berlandieriana, *Mor.*
griseola, *Pfr.*
*
fidelis, *Gray.*
infumata, *Gld.*
Hillebrandi, *Newc.*
*
arrosa, *Gld.*
Townsendiana, *Lea.*
tudiculata, *Binn.*
Nickliniana, *Lea.*
Ayresiana, *Newc.*
redimita, *W. G. Binn.*
intercisa, *W. G. Binn.*
exarata, *Pfr.*
ramentosa, *Gld.*
Californiensis, *Lea.*
Carpenteri, *Newc.*
Mormonum, *Pfr.*
sequoicola, *J. G. Coop.*
Diabloensis, *J. G. Coop.*
Traski, *Newc.*
Dupetithouarsi, *Desh.*
ruficincta, *Newc.*
facta, *Newc.*
Gabbi, *Newc.*
*

Helix Newberryana, *W. G. Binn.*
*
Kelletti, *Fbs.*
Tryoni, *Newc.*
*
hortensis, *Müll.*
*
aspersa, *Müll.*
*
varians, *Mke.*
Holospira Roemeri, *Pfr.*
Goldfussi, *Pfr.*
Cylindrella Poeyana, *Pfr.*
jejuna, *Gld.*
Macroceramus Kieneri, *Pfr.*
Gossei, *Pfr.*
Bulimulus multilineatus, *Say.*
Dormani, *W. G. B.*
Marielinus, *Pfr.*
Floridanus, *Pfr.*
patriarcha, *W. G. B.*
alternatus, *Say.*
Schiedeanus, *Pfr.*
dealbatus, *Say.*
Cionella subcylindrica, *L.*
acicula, *Müll.*
Stenogyra decollata, *L.*
subula, *Pfr.*
octonoides, *Ad.*
gracillima, *Pfr.*
Pupa muscorum, *L.*
Blandi, *Morse.*
Hoppii, *Müll.*
variolosa, *Gld.*
pentodon, *Say.*
decora, *Gld.*
corpulenta, *Morse.*
Rowelli, *Newc.*
Californica, *Rowell.*
fallax, *Say.*
modica, *Gld.*

Pupa Arizonensis, *Gabb.*
hordeacea, *Gabb.*
armifera, *Say.*
contracta, *Say.*
rupicola, *Say.*
corticaria, *Say.*
pellucida, *Pfr.*
borealis, *Mor.*
Strophia incana, *Binn.*
Vertigo Gouldi, *Binn.*
Bollesiana, *Morse.*
milium, *Gld.*
ovata, *Say.*
ventricosa, *Morse.*
simplex, *Gld.*

(*Orthalicinæ.*)

Liguus fasciatus, *Müll.*
Orthalicus zebra, *Müll.*
Orthalicus undatus, *Brug.*
Punctum minutissimum, *Lea.*

(*Succininæ.*)

Succinea Haydeni, *W. G. B.*
retusa, *Lea.*
Sillimani, *Bld.*
ovalis, *Gld.*, not *Say.*
Higginsi, *Bld.*
Haleana, *Lea.*
Mooresiana, *Lea.*
Grosvenori, *Lea.*
Wilsoni, *Lea.*
Concordialis, *Gld.*
luteola, *Gld.*
lineata, *W. G. Binn.*
avara, *Say.*
Succinea Stretchiana, *Bld.*
Verrilli, *Bld.*
aurea, *Lea.*
Groenlandica, *Beck.*
obliqua, *Say.*
Totteniana, *Lea.*
campestris, *Say.*
Hawkinsi, *Bd.*
rusticana, *Gld.*
Nuttalliana, *Lea.*
Oregonensis, *Lea.*
effusa, *Shuttl.*
Salleana, *Pfr.*

PHILOMYCIDÆ.

Tebennophorus Caroliniensis, *Bosc.*
Pallifera dorsalis, *Binn.*

VERONICELLIDÆ.

Veronicella Floridana, *Binn.*
Veronicella olivacea, *Stearns.*

During the many years in which my attention has been devoted to the Terrestrial Pulmonata of North America, I have lost no opportunity of adding to the knowledge of their geographical distribution, presented by my father in the first volume of his work.* The result of

* A. Binney, Terr. Moll. U. S., I. Chaps. V.–IX.

this accumulation of facts is here briefly offered. It must be studied in connection with the chapters referred to, and also with the text-book of our land shells, prepared for the Smithsonian Institution by my friend, Mr. Bland, and myself.*

The regions west of the Rocky Mountains have become known since the publication of my father's work, and much additional information received from the eastern portion of the continent. It becomes necessary, therefore, somewhat to modify the limits of the sections which he indicated. I have already suggested † that, in regard to the geographical distribution of the Terrestrial Pulmonata of North America, there appear to be three distinct faunas, which I have called, —

I. The Pacific Province.
II. The Central Province.
III. The Eastern Province.

The boundaries of these provinces and the subdivisions which appear to exist in them will be given below, as well as lists of their peculiar species. It must be distinctly understood, however, that future researches, especially at the South and Southwest, may greatly modify the views here presented.

I. The Pacific Province comprises a narrow strip between the Sierra Nevada and Cascade Mountains on the east, and the Pacific Ocean on the west. Its southern limit is San Diego, from whence it extends northerly into Alaska.

Over this province the following species range : —

Macrocyclis Vancouverensis.
sportella.
Helix Columbiana.
germana.
tudiculata.
Ariolimax Columbianus.
Prophysaon Hemphilli.
Succinea rusticana.
Oregonensis.
Nuttalliana.

Over the whole of this province we find also the following species, common to Eastern North America. They also extend over the whole northern portion of the continent, where the mountains have ceased to

* Land and Freshwater Shells of North America, Part I. Pulmonata Geophila. By W. G. Binney and Thomas Bland, Washington, 1869.

† Proc. Bost. Soc. Nat. Hist., IX. 177, 1863.

be barriers to distribution. It is, no doubt, from these regions that they have spread through the Pacific Province, and not westward over the Rocky Mountains. Had other eastern species extended over the boreal regions, we should, no doubt, have found them also spreading into the Pacific States. They are especially found along the Sierra Nevada.

Zonites arboreus.	**Limax campestris.**
indentatus.	**Patula striatella.**
minusculus.	**Helix lineata.**
milium.	**Punctum minutissimum.**

In the Pacific Province we also find several species common to the circumpolar regions of Asia, Europe, and America. They have likewise spread southward along the Sierra Nevada and on either side of it. They have also spread southward over the Central and Eastern Provinces, and now inhabit most, if not all, of North America. They are

Zonites fulvus.	**Cionella subcylindrica.**

Other species will probably be added to this list by further search; among them *Helix pulchella.*

In dealing with the species from the North in Eastern North America (see below, p. 204), the question of their distribution will be more fully discussed.

In addition to the species already enumerated as common to the whole Pacific Province, there are many more restricted in their range. It appears that the Pacific Province is divided into two regions, (*a*) the Oregonian and (*b*) Californian, the two intermingling slightly or overlapping in the extreme north of California, near Humboldt Bay. The faunas of these regions are nearly allied.

(*a.*) The Oregon Region lies between the Cascade Mountains and the Pacific Ocean, extending northerly through British Columbia into Alaska. The following species are peculiar to it: — *

Helix devia.	**Arion foliolatus.**
fidelis.	**Hemphillia glandulosa.**
Townsendiana.	**Succinea Hawkinsi.**

There seems to be here some overlapping of the Pacific and Central Provinces, as *Helix Townsendiana*, *Helix devia*, and *Macrocyclis Van-*

* I omit *Onchidella borealis*, Dall, from Sitka, being doubtful whether the genus should be treated as American.

couverensis extend along the mountains southeasterly into Idaho and Montana. The former two become much dwarfed in size at their most eastern range.

(*b.*) The Californian Region extends from Humboldt Bay to San Diego, between the Sierra Nevada and Cascade Mountains on the east, and the Pacific Ocean on the west.

The following are the species peculiar to it : —

Macrocyclis Voyana.
Duranti.
Vitrina Pfeifferi.
Zonites Whitneyi.
conspectus.
chersinellus.
Limax Hewstoni.
Binneia notabilis.
Ariolimax Californicus.
niger.
Arion ? Andersoni.
Helix Yatesii.
Harfordiana.
loricata.
infumata.
Hillebrandi.
arrosa.
Nickliniana.
Ayresiana.
redimita.
intercisa.
Helix exarata.
ramentosa.
Californiensis.
Diabloensis.
Carpenteri.
Mormonum.
sequoicola.
Traski.
Dupetithouarsi.
ruficincta.
Gabbi.
facta.
Kelletti.
Tryoni.
Newberryana.
Pupa corpulenta.
Rowelli.
Californica.
Succinea Sillimani.
Stretchiana.

Of the above, several species extend beyond the limits of the region. Thus, *Vitrina Pfeifferi*, *Zonites Whitneyi*, *Pupa corpulenta*, *Succinea Sillimani*, *Succinea Stretchiana*, and *S. rusticana* are found also on the western slope of the Sierra Nevada in the Central Province. *Helix infumata* and *Macrocyclis Voyana* are also found outside the bounds of the Region, in the Oregonian Region.

With the fauna of Lower California there seems no connection, unless *Helix Stearnsiana* proves identical with *H. Kelletti*, in which case the former must be considered as belonging to the Lower California fauna rather than to that of our Pacific Province. Another species, *H. Carpenteri*, is included in the above list, having been quoted from San Diego

and Tulare Valley, California. It may, however, belong rather to the Lower California fauna,* having been described from that region under the name of *H. Remondi*, and from Guaymas. *Veronicella olivacea*, Stearns, a Nicaraguan species, is also said to extend into California.

From the list of California species are omitted *Columna Californica*, actually collected at Marmato, New Granada, by Mr. Bland, and

* The peninsula of Lower California forms a distinct molluscous province of itself, extending nearly to San Diego. The following species are peculiar to it: —

Cœlocentrum irregulare, *Gabb.*
Helix Stearnsiana, *Newc.* (*Kelletti*, Fbs. ?)
areolata, *Sowb.* (*Veitchii*, Tryon
Pandoræ, *Forbes.*
levis, *Pfr.*
Rowelli, *Newc.* (*Lohri*, Gabb.)
Berendtia Taylori, *Pfr.*
Bulimus spirifer, *Gabb.*
Gabbi, *Crosse.*
Bulimulus pallidior, *Sowerby.*
excelsus, *Gould.*
inscendens, *W. G. Binn.*
sufflatus, *Gould.*
pilula, *W. G. Binn.*
proteus, *Brod.*
Xantusi, *W. G. Binn.*
artemisia, *W. G. Binn.*
Onchidium Carpenteri, *W. G. Binn.*

Veronicella olivacea, Stearns, a Nicaraguan species, is also found in Lower California. Of the above list one only has been found near San Diego, *H. Stearnsiana*. Another, *H. Rowelli*, has been referred to Arizona, but with doubtful accuracy. *H. Pandoræ* and *areolata* have also erroneously been referred to California. *Helix Remondi* (*Carpenteri*) is omitted from the list, as it also occurs in the California Region. It is the only species common to the peninsula and mainland of Mexico. The most interesting fact in the fauna of Lower California is the presence of *Bulimulus proteus* and *B. pallidior*, — species described originally from South America, the former from Chili. Such facts can only be accounted for by a theory of former connection of the two points.

Though still more remotely connected with the subject of this paper, it will be interesting to add here a list of species found at and north of Mazatlan, on the Pacific coast of Mexico.

Glandina turris, *Pfr.*
Albersi, *Pfr.*
Holospira Remondi, *Gabb.*
Helix Mazatlanica, *Pfr.*
Carpenteri, *Newc.*
anilis, *Gabb.*
Behri, *Gabb.*
Helix acutedentata, *W. G. Binn.*
ventrosula, *Pfr.*
Bulimulus Ziegleri, *Pfr.*
Californicus, *Rve.* ?
Orthalicus undatus, *Brug.*
Pupa chordata, *Pfr.*
Succinea cingulata, *Forbes.*

Of the above, *H. Mazatlanica* has lately been quoted from San Francisco, confounded probably with some allied species.

H. Mormonum is omitted from this list, its presence in Sonora not having been confirmed, although asserted, doubtfully, by Messrs. Fischer and Crosse.

Zonites cultellatus, probably an accidentally introduced European shell. *Bulimus Californicus* is also omitted, belonging, no doubt, to the region of Mazatlan. Also *Glandina Albersi*, which we know to live in the Sierra Madre.

Separate lists of species peculiar to the several regions of the Pacific Province are given above. There now follows a complete list of all the species hitherto observed in the entire Province.

Macrocyclis Vancouverensis.
sportella.
Voyana.
Duranti.

Zonites Whitneyi.
arboreus.
indentatus.
minusculus.
milium.
conspectus.
chersinellus.
fulvus.

Vitrina Pfeifferi.

Limax campestris.
Hewstoni.

Prophysaon Hemphilli.

Ariolimax Columbianus.
Californicus.
niger.

Arion? follolatus.
Andersoni.

Binneia notabilis.

Hemphillia glandulosa.

Patula striatella.

Helix lineata.
Yatesii, *J. G. C.*, not *Pfr.*
Harfordiana.
loricata.
Columbiana.
germana.
devia.
fidelis.
infumata.
Hillebrandi.
arrosa.
Townsendiana.
tudiculata.
Nickliniana.
Ayresiana.
redimita.
intercisa.
exarata.
ramentosa.
Californiensis
Carpenteri.
Mormonum.
sequoicola.
Diabloensis.
Traski.
Dupetithouarsi
ruficincta.
facta.
Gabbi.
Kelletti.
Tryoni.
Newberryana.

Cionella subcylindrica.

Pupa Rowelli.
Californica.
corpulenta.

Succinea Sillimani.
Stretchiana.
Hawkinsi.
rusticana.
Nuttalliana.
Oregonensis.

Punctum minutissimum.

Veronicella olivacea.

Several of the above will eventually prove to be synonymes, but the total number of species is small in comparison with the great size of the Pacific Province. An equal extent of territory in the Mississippi Valley, or even on the Atlantic coast, would show a larger number; and the comparatively small regions of Texas, Florida, and the Cumberland Mountains would each show an equal number of species peculiar to itself, independent of what they have in common with the rest of Eastern North America. This disparity in number is still more plainly shown in the separate region of Oregon. Thus it appears that the Pacific Province is not rich in the number of its species, but it is peculiarly favored in their size and beauty, — in this respect strikingly in contrast with the Central Province and Eastern Province.

From the Central Province the Pacific Province is quite distinct. A few species have been shown above to inhabit both slopes of the Sierra Nevada, and a few of the Oregon species have passed the barrier of the Cascade Mountains on the north, but the peculiar Pacific forms, such as *Arionta* and *Aglaia*, are unknown in the Central Province. On the other hand, the only form which has any development in the Central Province, *Patula*, is scarcely known in the Pacific Province.

Compared with Eastern North America, or the Eastern Province, as it is designated below, the Pacific Province is remarkable for the absence of all the larger *Zonites*. The presence of the smaller species, also, may perhaps be accounted for by migration from the north, so that the genus *Zonites* cannot be considered as characteristic of the Province. The genus *Pupa* is less common. The genera *Tebennophorus* and *Pallifera*, so universally distributed in Eastern North America, are unknown, and so are the southern genera *Glandina*, and *Bulimulus*. On the other hand, we find the genus *Macrocyclis* much more developed, and meet several genera unknown in the Eastern Province, such as *Ariolimax*, *Binneia*, *Prophysaon*, and *Hemphillia*. The genus *Helix* is proportionally more developed in the Pacific Region, and is represented by quite dissimilar subgenera. The sections so peculiar to the Eastern Province, *Polygyra*, *Stenotrema*, *Triodopsis*, *Mesodon*, are scarcely represented. In their place we find *Aglaia* and *Arionta*, forms unknown in the Eastern Province. The latter, though feebly represented in Europe, is the form of *Helix* characteristic of California. It is prolific of species and also of varieties to a degree which has caused some confusion in the synonymy. The section to which *Helix Newberryana* belongs, *Glyptostoma*, is also peculiar to California.

From Lower California and Mexico the Pacific Region has been shown to be equally distinct, wanting entirely the *Holospira*, *Glandina*, *Bulimulus*, and *Zonites* of those regions.

Failing on the north, east, and south, the west alone is left to us from whence to trace the pulmonate fauna of the Pacific Region, and here the secret of its origin lies buried under the Pacific Ocean.*

II. The Central Province extends from Mexico to the British Possessions, between the Rocky Mountains on the east, and the Sierra Nevada and Cascade Mountains on the west.

The following are the species peculiar to the province: —

Patula strigosa.	**Patula Horni.**
Cooperi.	**Helix polygyrella.**
Haydeni.	**Mullani.**
Idahoensis.	**Pupa Arizonensis.**
Hemphilli.	**hordeacea.**

The first two of these species, perhaps identical, are also found on the eastern slope of the Rocky Mountains, in Wyoming and Dakota.

To the above must be added, as inhabiting the province, but not peculiar to it, the following species from the Pacific Province, inhabiting either slope of the Sierra Nevada: *Vitrina Pfeifferi*, *Zonites Whitneyi*, *Pupa corpulenta*, *Succinea Sillimani*, and *Succinea Stretchiana*. The following, also, from the Oregonian Region of the Pacific Province, *Helix devia*, *Helix Townsendiana*, and *Macrocyclis Vancouverensis*, are found at its most northern point, though the former two species are reduced in size. We find, also, over the Central Province the following species, whose derivation can readily be traced to the north; † *Zonites*

* A subsidence of eight hundred feet in the continent of North America would leave on its eastern shore a strip of land of about equal size of our Pacific Region, equally distinct in its terrestrial mollusca from the balance of the continent. In this case, however, we should have a distant island of the Appalachian chain on which we should find all the species of the eastern coast of the mainland. This would give us a proof of what we can now only suspect as regards the Pacific Province, — of former more wide distribution of its pulmonate fauna. From wherever the fauna may have originated, we can easily explain its present condition. The physical and climatic features of the Pacific Region are such as readily to account for its richness in terrestrial mollusks in comparison with the less favored Central Province, and even with the Eastern Province.

† See remarks on the distribution of these species over Eastern North America, p. 204.

minusculus, *fulvus*, *indentatus*, *Helix pulchella*, *H. lineata*, *Patula striatella*, *Cionella subcylindrica*.

Helix Rowelli, a Lower California species, is omitted from the list, its presence in Arizona not being well authenticated.

The fauna of the Central Province is quite distinct from that of the Pacific Province, but is nearly allied to that of the Eastern Province, its genera and subgenera being the same, excepting *Polygyrella*, its only peculiar subgenus of *Helix*. It may therefore be of the same origin as the fauna of the Eastern Province.

The paucity of species over this large province is owing to the nature of its climate and soil, — causes in equal force on the western border of the Eastern Province.

In order to avoid mistakes in the study of the geographical distribution of North American Land Shells one must constantly bear in mind the changes in the names and boundaries of the trans-Mississippi States and Territories.*

III. The Eastern Province comprises the remaining portions of the continent north of Mexico. The species by which it is inhabited have been derived partly from the north, partly from the interior, and partly from the south. It may, therefore, be divided into the (*a*) Northern Region, (*b*) the Interior Region, and (*c*) the Southern Region.

(*a*.) The Northern Region † comprises the whole northern portion of the continent, including Greenland and Alaska. Its southern boundary is not perfectly known, and probably not exactly marked; it may, however, be indicated in general terms as the same with the political division between the British Possessions and the United States to the northeast corner of New York, where it runs southwesterly along the Appalachian chain of mountains to Chesapeake Bay, thus including all New England, and the portions of New York, New Jersey, Pennsylvania, and Maryland lying east of those mountains. Into this

* Thus, *Helix Mullani* was described in Land and Freshwater Shells of North America, I. 131, from points in Washington Territory and Oregon. Both localities are now in Idaho.

† For a description of this Region, see A. Binney, l. c. pp. 124, 125, under sections 5 and 6. The American land shells, especially those of the Interior Region, are forest species; they become rare towards the northern region of the continent as the deciduous trees become rare.

southern extension of the Region we find the Interior Region overlapping, as will be shown below while treating of the Interior fauna. At other points in the Region, also, have been found species from the Interior Region,* especially small *Zonites*, which are able to bear the severe climate of the north.

The following are the species of the Northern Region : —

Vitrina limpida.
Angelicæ.
exilis.
Zonites fulvus.
nitidus.
viridulus.
Fabricii.
milium.
Binneyanus.
ferreus.
exiguus.
multidentatus.
Patula striatella.
asteriscus.
pauper.
Helix harpa.
Helix pulchella.
Cionella subcylindrica.
Pupa muscorum.
Blandi.
Hoppii.
decora.
borealis.
Vertigo Gouldi.
Bollesiana.
simplex.
Punctum minutissimum.
Succinea Haydeni.
Verrilli.
Higginsi.
Groenlandica.
Totteniana.

Of the above, several are circumpolar species, common to the three continents of Europe, Asia, and America. There being no mountain-barriers in these regions, they are not restricted in their range across America. In their progress southward, also, they have met with no transverse mountain-barriers, but have spread equally on the east and west of the Rocky Mountains and Sierra Nevada. Hence we find them common to the whole of North America.† Such are : —

* See Proc. Phila. Acad., N. S., 1861, p. 330, for the northern range of species from the Interior Region.

† In the same way we can account for the distribution of the small eastern species over the Central and Pacific Provinces. They have not crossed the mountain-barriers, but spread southward from their wider range in the north. Such are : —

Zonites arboreus.
indentatus.
minusculus.
milium.
Limax campestris.
Patula striatella.
Helix lineata.
Punctum minutissimum.

These northern species, both indigenous and circumpolar, may have been assisted

Zonites viridulus.
fulvus.
nitidus.
Helix harpa.
Helix pulchella.
Cionella subcylindrica.
Pupa muscorum.

This list will be increased should it be proved that Mr. Gwyn Jeffreys * is correct in referring the following American species to those of Europe. Vitrina limpida = V. pellucida, Punctum minutissimum = Helix pygmæa, Drap., Limax campestris = L. lævis, Müll., Vertigo Gouldii = V. alpestris, Ald., Vertigo Bollesiana = V. pygmæa, Drap., V. ovata = V. antivergo, Drap., V. ventricosa = V. Moulinsiana, V. simplex = V. edentula, Drap., Succinea ovalis = S. elegans, Risso, S. Totteniana = S. putris, Drap. var.

From Asia have come into Alaska the following: *Vitrina exilis*, *Patula pauper*, *Pupa borealis*.

The species peculiar to Greenland are *Vitrina Angelicæ*, *Zonites Fabricii*, *Pupa Hoppii*, and *Succinea Groenlandica*. Of these, *Pupa Hoppii* has, however, also been found on Anticosti Island.

Into this Northern Region have also been introduced by commerce from Europe the following: *Zonites cellarius*, at most of, if not at all of, the ports from New York to Halifax; *Limax flavus*, *L. agrestis*, and *Arion fuscus*, which follow man over the whole United States, living around his habitations; and *L. maximus*, also around human habitations, but noticed only in Newport, R. I., New York City, and Philadelphia; *Helix hispida* at Halifax, *Helix rufescens* at Quebec, *Helix hortensis* on the islands off the coast of New England and the British Provinces, and on the mainland in Canada and Greenland.

Of the species referred above to the Northern Region, several have spread beyond its limits. *Vitrina limpida* has been found in Central New York; *Zonites viridulus* extends to Mexico; *Z. milium* to San Francisco; *Z. fulvus* and *Helix pulchella* all over the United States; *Zonites nitidus*, *Z. multidentatus*, and *Punctum minutissimum* to Ohio, the last to Texas and to California; *Cionella subcylindrica* to the States south of the Great Lakes and into California and New Mexico; *Patula striatella* to Virginia, as well as into Oregon and Nevada.

in their migration southward by glacial agencies. There is a wide field for speculation here.

* Ann. and Mag. N. H., 1872, 245, 246.

The Northern Region does not differ in the characteristics of its fauna from that lying south of it, but its climate is too severe for any but the more hardy forms. Thus, we find only the small *Zonites* and *Helix*, with the genus *Vitrina*. Compared with the balance of North America, the Region is peculiar for the great distribution of its species east and west, owing to the mountain-ranges having here lost the great elevation which they have farther south, and thus ceasing to be barriers to distribution. The Region is also interesting as being the source from whence have spread southward over the whole continent several small species now found in Florida and Texas, and even in Mexico and the West Indies.

(*b.*) The Interior Region lies to the south of the Northern Region, but extends only as far as the Rocky Mountains * on the west. Southerly it extends to the alluvial regions of the Atlantic and Gulf coasts, the dividing line here not being sharply defined.

This is the only portion of the continent where we have evidence of the origin of our land mollusks in former geological times. In the Post-pleiocene deposits along the Ohio and Mississippi Rivers are found immense beds of shells, "proving that our existing species were living at a period which, though recent in a geological sense, was anterior to the last geological revolution, when the surface of this portion of the earth was brought to its present condition, and to the existence of the higher order of animals which now inhabit it, and even to that of the extinct mammalians which are known only by their gigantic remains." †

From the evidence gathered from these deposits, it appears that the fauna of this Region can be traced to Indiana and Ohio. From this centre the species have extended over the Region; some of them also have passed the barrier of the Appalachian chain into the Northern Region, and some have spread, with the enlargement of the continent, into the Southern Region.

The following species have actually been found fossil in the Post-pleiocene deposits: — †

Zonites arboreus.	**Zonites intertextus.**
fuliginosus.	**ligerus.**
inornatus.	**gularis.**

* This is the extreme limit, but before reaching it the land shells have become very rare, owing to the nature of the soil. For a description see A. Binney, l. c.

† A. Binney, Terr. Moll. U. S., I. 185.

Macrocyclis concava.
Patula solitaria.
alternata.
perspectiva.
Helix lineata.
labyrinthica.
auriformis.
stenotrema.
hirsuta.
monodon.
palliata.
obstricta.
appressa.
Helix inflecta.
albolabris.
elevata.
exoleta.
thyroides.
clausa.
profunda.
Pupa armifera.
contracta.
Succinea obliqua.
Helicina* orbiculata.
occulta.

Of the above all are now living and are equally numerous, excepting *Helicina occulta*, a species most abundant in Post-pleiocene days, but now almost extinct.† The other species of *Helicina* is now confined to more southern limits.

In addition to the above, the following species, now living in the Interior Province, probably had their origin in Post-pleiocene times, and will, no doubt, be found fossil in the "bluffs": —

Zonites friabilis.
lævigatus.
suppressus.
indentatus.
internus.
minusculus.
limatulus.
Helix Dorfeuilliana.
leporina.
multilineata.
Pennsylvanica.
Mitchelliana.
dentifera.
Helix bucculenta.
Sayii.
tridentata.
fallax.
Pupa pentodon.
fallax.
rupicola.
corticaria.
Vertigo milium.
ovata.
Succinea avara.
ovalis.

* Though not *Pulmonata*, these two species are strictly terrestrial in their habits, and are here introduced from their value on the question of the permanence of the Post-pleiocene species. One of them is almost extinct, the other more restricted in its range at present.

† See A. Binney, Terr. Moll. U. S., I. 183, 184; Bland and Binney, Ann. Lyc. N. H. of N. Y., IX. 289.

Tebennophorus Caroliniensis, *Pallifera dorsalis*, and *Limax campestris* probably have also come down from Post-pleiocene times. From their nature they could leave no record of their presence in the "bluffs."

There are also found in the Interior Region several forms of *Succinea* which have been described as

Succinea retusa.
Succinea aurea.
Grosvenori.
Mooresiana.
lineata.

The following is a complete list of those species of the Interior Region which have spread beyond it by passing the barriers of the Appalachian chain, and are now found over New England and the whole southern extension of the Northern Region, described on p. 203, as well as over the whole Southern Region. They may, therefore, be said to inhabit all of the Eastern Province.

Macrocyclis concava.
Zonites fuliginosus.
inornatus.
suppressus.
indentatus.
arboreus.
minusculus.
Limax campestris.
Patula alternata.
Helix lineata.
labyrinthica.
hirsuta.
monodon.
palliata.
tridentata.
Helix fallax.
albolabris.
thyroides.
Pupa pentodon.
fallax.
armifera.
contracta.
rupicola.
corticaria.
Vertigo milium.
ovata.
Succinea avara.
obliqua.
Tebennophorus Caroliniensis.
Pallifera dorsalis.

Helix Sayii and *Helix dentifera* have spread into New England only from the Interior Region. They have not been found in more southern latitudes on the Atlantic slopes of the Appalachian chain, nor in the Southern Region.

The geographical range of these species is very great, forming one of the most striking features of the North American fauna. Still more widely distributed are those minute species which have been mentioned above as spreading southwardly from the Northern Region equally on both sides of the Sierra Nevada and Rocky Mountains. These species

may be said to inhabit the whole continent of North America as far south as Mexico. The range of some is still greater. Thus, *Zonites minusculus* has been found from British Columbia to Labrador on the north to Yucatan and Florida on the south, and still farther in Cuba, Jamaica, Porto Rico, and Bermuda. *Helix labyrinthica* also is found over all Eastern North America, and perhaps in Mexico (as *H. Strebeli*, see Fischer and Crosse, Moll. Mex. et Guat., 267). It is also by some considered identical with an Eocene fossil of France and England. (See Land and Freshw. Shells N. A., I. 84.) *Zonites arboreus* ranges from Labrador to New Mexico, and in Nevada and California, and from British Columbia to Florida, Cuba, and Guadaloupe. *Vertigo ovata* is found from Maine to Mexico and in Cuba.

The character of the soil and climate, with, perhaps, the gradual elevation, is such as to render the land shells rare, if not quite extinct, before the Rocky Mountains are reached, the western boundary of the Interior Region. But one species, *Patula solitaria*, seems to have passed this mountain-barrier into the Central Province. This is found with *P. Cooperi* in Montana and Idaho, very difficult to distinguish from forms of the last species. It is, however, oviparous (from Salmon River, Idaho), while *P. strigosa*, *Cooperi*, *Hemphilli*, and *Idahoensis* are viviparous. It has been suggested by Dr. H. Dohrn that this characteristic is connected with the fact of the great dryness of the soil in the Central Province. The young shell is ready to protect itself from the moment of its birth, while, if deposited as an egg by the parent, it might perish from drought.

The following list contains the names of all the species inhabiting the Interior Region, including those which have spread into it from the Northern Region : —

Macrocyclis concava.
Zonites fuliginosus.
friabilis.
lævigatus.
ligerus.
intertextus.
inornatus.
nitidus.
arboreus.
viridulus.
Zonites indentatus.
limatulus.
minusculus.
fulvus.
gularis.
suppressus.
internus.
Limax campestris.
Patula solitaria.
alternata.

Patula perspectiva.
striatella.
Helix lineata.
labyrinthica.
Dorfeuilliana.
leporina.
auriformis.
stenotrema.
hirsuta.
monodon.
palliata.
obstricta.
appressa.
inflecta.
tridentata.
fallax.
albolabris.
multilineata.
Pennsylvanica.
Mitchelliana.
elevata.
exoleta.
dentifera.
thyroides.
clausa.
Helix profunda.
Sayii.
harpa.
pulchella.
Pupa muscorum.
pentodon.
fallax.
armifera.
contracta.
rupicola.
corticaria.
Vertigo milium.
ovata.
Succinea retusa.
Grosvenori.
Mooresiana.
ovalis.
lineata.
avara.
aurea.
obliqua.
Totteniana.
Tebennophorus Caroliniensis.
Pallifera dorsalis.

The above list shows the Interior Region to be remarkable for the development of the section of *Zonites* familiar by the European *Z. olivetorum* (*Mesomphix* of Alb. ed. 2). In the genus *Helix* the section or subgenus *Mesodon* is most developed. This is almost exclusively a North American subgenus, as is also *Triodopsis*, which is also greatly developed in the Interior Region.

In addition to the species included in the above list as inhabiting all of the Interior Region, there is a large group of species found within its limits, but having a more restricted range. They are found in what may be called the Cumberland Sub-Region. This is comprised in the southern portion of the Appalachian chain, situated in Eastern Tennessee and the adjoining counties of North Carolina, with an offshoot into the mountains of West Virginia.*

* For a description of its physical and climatic characters, see Dr. A. Binney, Terr. Moll. U. S., I. 122. It is there designated as the Southern Interior Section, and is given a wider western range.

The following species are peculiar to this Sub-Region : —

Zonites kopnodes.
subplanus.
sculptilis.
Elliotti.
demissus.
capsella.
lasmodon.
Patula Cumberlandiana.
tenuistriata. ?
Helix fastigans.
Troostiana.
Hazardi.
Helix spinosa.
labrosa.
Edgariana.
Edvardsi.
barbigera.
maxillata.
Rugeli.
introferens.
Clarki.
Christyi.
Wheatleyi.
Downieana.

Of these, several have spread beyond the limits given above for the Sub-Region. Thus, *Zonites lasmodon* and *Helix spinosa* have been found in Northern Alabama. *Helix Hazardi* has also spread into Northern Alabama, and equally into Georgia and Kentucky. *Helix labrosa* and *Helix Edgariana* in Alabama, and in one case have been collected in Arkansas. *Helix barbigera*, *Helix maxillata*, and *Zonites kopnodes* have found their way into Alabama and Georgia; *Helix Clarki* into Georgia. *Zonites subplanus* has been found even in Pennsylvania, having, no doubt, crept along the mountain chain; but no other of the species of the Cumberland Sub-Region has been found as far north, excepting *Z. demissus*. This last-named species is found in a highly developed state in Eastern Tennessee, and has extended into Western Pennsylvania, North Carolina, Georgia, Alabama (near Mobile), and Arkansas in a much dwarfed condition.

If to the twenty-four species catalogued above as peculiar to the Sub-Region are added the sixty-six species which inhabit it as a portion of the Interior Region (see p. 209), it will be seen that in the Cumberland Sub-Region we find the largest number of species of any other portion of North America. The Sub-Region is equally prolific in individuals, and the individuals are highly developed. These facts are partially explained by the nature of the country. Low mountains, thickly shaded, well watered, and with a genial climate and proper soil, offer in their thickets and ravines innumerable safe breeding-grounds for the land shells.*

* See A. Binney, Terr. Moll. U. S, I. pp. 122, 123. Being less adapted for cultivation than the balance of Eastern North America, we may hope for the preservation

There seems also to be in this Sub-Region conditions peculiarly conducive to testaceous variation. Six (or twenty-five per cent) of its peculiar species are carinated, and here also the following species of the Interior Region show the same tendency to carination, — *Zonites ligerus*, *intertextus*, *Patula alternata*, *Helix appressa* and *palliata*. Here, also, we first notice the variation of *Patula alternata* towards heavy ribs upon its shell; which is still more apparent as the species extends towards the southwest.*

The Cumberland Sub-Region is peculiar for the development of *Zonites*, and in the genus *Helix* for the development of the section or subgenus *Stenotrema*, almost peculiar to these narrow limits.

(*c.*) The Southern Region comprises the peninsula of Florida, with the adjacent islands, together with the alluvial regions of the Atlantic and Gulf coasts. It includes, therefore, the eastern portion of North Carolina, South Carolina, Georgia, all of Florida, the southern part of Alabama, Mississippi, Louisiana, extending into Texas.† Its boundaries, however, are but imperfectly known, and probably not accurately defined. Many of the species from the Interior Region and Cumberland Sub-Region have spread into its northern portion, and the following have extended over the larger portion of it: —

Macrocyclis concava.
Zonites fuliginosus.
inornatus.
suppressus.
indentatus.
arboreus.
minusculus.
Limax campestris.
Patula alternata.
Helix lineata.
labyrinthica.
hirsuta.
monodon.
palliata.
tridentata.
Helix fallax.
albolabris.
thyroides.
Pupa pentodon.
fallax.
armifera.
contracta.
rupicola.
corticaria.
Vertigo milium.
ovata.
Succinea avara.
obliqua.
Tebennophorus Caroliniensis.
Pallifera dorsalis.

of our land shells in this Region, while they decrease rapidly before the advance of civilization elsewhere. See *Ibid.*, pp. 132, 133.

* This heavily ribbed form was common in Post-pleiocene days.

† See A. Binney, Terr. Moll. U. S., I. 120, for a description of the Region.

Equally wide over the Region has been the distribution of those minute species whose origin has been traced to circumpolar regions (see p. 205). Such are: *Zonites viridulus*, *fulvus*, and *Helix pulchella*.

In addition to these species derived from the north, are found the following species peculiar to the Region, whose origin can be traced to the south, in the peninsula of Florida, from whence, indeed, many of them have not yet spread over the whole Region: —

Glandina truncata.
Zonites cerinoideus.
Helix auriculata.
uvulifera.
Postelliana.
espiloca.
avara.
cereolus.
septemvolva.
Carpenteriana.
Febigeri.
pustula.
pustuloides.
Helix Hopetonensis.
major.
jejuna.
Bulimulus Floridanus.
Dormani.
dealbatus.
Cylindrella jejuna.
Pupa variolosa.
modica.
Succinea effusa.
campestris.
Wilsoni.
Veronicella Floridana.

Of the more widely spread species, *Helix septemvolva* is represented by various forms over the whole southern littoral region, both of the Atlantic and Gulf. So is *Glandina truncata*, *Helix jejuna*, *pustula*, *pustuloides*, and *Pupa modica*. *Helix Hopetonensis* and *major* extend only along the Atlantic alluvial Region. *Bulimulus dealbatus* is also distributed over the whole Region, from North Carolina to Texas, and has spread northward to Arkansas and Kentucky. *Succinea campestris* extends along the Atlantic coast as far as South Carolina, as does also *Zonites cerinoideus*, even into North Carolina. *Helix espiloca* and *Postelliana* have been noticed thus far in the southeastern corner of Georgia. The former also at New Orleans and Indianola. *Succinea Wilsoni*, at Darien, Ga.

The following European species have been introduced by commerce into this Region, and still exist at the points named: *Stenogyra decollata*, Lin., and *Helix aspersa*, Müll., at Charleston, S. C.; *Acicula acicula*, Müll., Florida.

From the list of species peculiar to the Southern Region it will be

seen that the prevailing form is *Polygyra*, a group or subgenus peculiarly American, represented in the Interior Region indeed, but meeting its greatest development here. The presence of *Glandina* and *Veronicella* shows, also, the more southern character of land-shell fauna. But the Region, and especially that portion of it from whence the fauna was distributed, i. e. the southern extremity of Florida, is still more peculiar in showing the connection between the land shells of the continent of North America and those of the West India Islands and the Spanish Main. Of the species given above (p. 213), *Cylindrella jejuna* was, perhaps, introduced from Cuba, and *Bulimulus Dormani* may prove identical with *B. maculatus*, Lea, of Carthagena. The following species have evidently been introduced* from the West India fauna: — †

Zonites Gundlachi, Cuba, etc.
Patula vortex, Cuba, etc.
Helix varians, New Providence.
Cylindrella Poeyana, Cuba.
Macroceramus Kieneri, Cuba.
Gossei, Cuba.
Bulimulus Marielinus, Cuba.
Strophia incana, Cuba.
Stenogyra subula, Cuba, etc.
gracillima, Cuba, etc.
Liguus fasciatus, Cuba.
Orthalicus undatus, Cuba.

From Yucatan one species has been introduced, *Helix oppilata*. *Orthalicus zebra*, found in several of the Florida keys, is, no doubt, of foreign origin, though from what point introduced it is difficult to say. It has been found in Mexico in the Sierra Madre, and in Maranhon. *Bulimulus multilineatus* was introduced ‡ from the continent of South America, where it has been found at St. Martha, N. Granada, and at Maracaibo and Pto. Cabello in Venezuela.

Florida has not only received several of its species from the West Indies, but also from its southern extremity it has contributed in return to the fauna of those islands. From hence, no doubt, *Zonites arboreus* has passed into Cuba and Guadaloupe; *Zonites minusculus* to Cuba, Jamaica, Porto Rico, (Bermuda?) *Pupa fallax* to Cuba; *Vertigo ovata* to Cuba; *Zonites indentatus* to San Domingo?

* Either by oceanic currents since the formation of the peninsula of Florida, or else from some island of the West India group, now enclosed in the peninsula. It is interesting in this connection to refer to the discovery, by Mr. Conrad, of a Tertiary fossil at Tampa Bay, *Bulimus Floridanus*, Conr. See also below, p. 217.

† Also several non-pulmonate species, as *Helicina subglobulosa*, Cuba; *Ctenopoma rugulosum*, Cuba; *Chondropoma dentatum*, Cuba.

‡ See note † to p. 216.

From the various sources indicated above the southern extremity of Florida has become inhabited by about seventy species of land shells, a number small in comparison with those found in the Cumberland Sub-Region (see p. 211), but large when compared with those found in the great Interior Region.

In addition to those species apparently originating in the peninsula of Florida and thence spreading over the whole Southern Region, there is found within its limits a number of species confined to its southwestern portion. These seem restricted to the southern part of Texas, which may be considered an offshoot of the Mexican fauna as shown by the presence of the genera characteristic of that country, such as *Holospira*, *Bulimulus*, and *Glandina*. Within the region, however, are many species peculiar to it, but belonging to the subgenera characteristic of North America, such as *Polygyra* and *Mesodon*. It seems, therefore, best to consider Texas as belonging equally to the fauna of North America and of Mexico, being the point where the two overlap. As the limits of the region are ill defined, several species extralimital to the State of Texas are included in the following catalogue of the Texan Region: —

Glandina Vanuxemensis.
decussata.
parallela.
bullata.
Texasiana.
Zonites significans.
caducus.
Patula incrustata.
Helix Hubbardi.
ventrosula.
Hindsi.
Texasiana.
triodontoides.
Mooreana.
tholus.
hippocrepis.
Jacksoni.
Ariadne.
Helix vultuosa.
divesta.
Roemeri.
Berlandieriana.
griseola.
Bulimulus patriarcha.
alternatus.
Schiedeanus.
Macroceramus Gossei.
Holospira Goldfussi.
Roemeri.
Stenogyra octonoides.
Pupa pellucida.
Succinea Haleana.
concordialis.
luteola.
Salleana.

Of the above *Helix Jacksoni* and *Zonites significans* are included with great hesitation. They are found at Fort Gibson, in Indian Ter-

ritory.* They are more related to the fauna of the Cumberland Sub-Region than that of Texas.

Besides the species characteristic of the North American fauna which Texas has as a portion of the Southern Region of the great Eastern Province, we find in the above list two species peculiar to it of the characteristic American subgenus *Mesodon*, *Helix Roemeri* and *H. divesta*.†

Several species on the list have been introduced from other regions,‡ such as *Helix Hubbardi*,§ a Jamaica species, as well as *Macroceramus Gossei*, a Cuban species, which is also found on the Florida Keys. *Patula incrustata* from Cuba, as well as *Pupa pellucida* and *Stenogyra octonoides*.

Of the remaining species on the list, sixteen have actually been found in Mexico; probably all will be, as there seems no well-defined boundary here between the North American and Mexican fauna.

Bulimulus serperastrus, Say, although actually found in Texas, is evidently a member of the Mexican fauna, and is therefore omitted from my list.

The characteristic of Texas appears to be the great preponderance of the subgenus *Polygyra*, of the type of *H. Texasiana*, while the type of Florida, the *septemvolva*, is quite wanting. The great abundance of individuals is also remarkable, showing the Region to be peculiarly adapted to pulmonate life. In the number of its species, also, the Texas Region is favored; by adding to the above list of peculiar species those which it has in common with all of the Eastern Province, and also those of the Southern Region, we find a total of seventy species, the same number as found in Florida.

* A. Binney, Terr. Moll., I. 122, gives the limits of the corresponding "Southern Interior Section" such as would include these species. Several of the species of East Tennessee, also, have been found in Arkansas, — a fact also favoring a wider limit to the Cumberland Sub-Region.

† This species has not actually been found within the limits of the State of Texas, but in the neighboring State of Arkansas and in Mississippi. To it may be applied the remarks on *Zonites significans* and *Helix Jacksoni* on p. 215.

‡ Either by commerce, by oceanic currents, or from some former molluscous fauna of which these now isolated localities were offshoots.

§ Since the above was written, this species has been found by Dr. Newcomb near Savannah, Ga. It may therefore prove a widely distributed American species. In Jamaica it is known as *H. Vendreysiana*, Gloyne.

On the accompanying map the Pacific Province is colored pink, the Central Province* blue; the Eastern Province (of which the northern portions are not shown) is uncolored. The subdivisions, or regions, of the Eastern Province are also indicated by colored lines. The red line marks the division between the Northern and Interior Regions. From this line the last-named region extends (its Sub-Region of the Cumberland shown by green lines) to the brown and yellow lines, which, taken together, mark the northern boundary of the Southern Region, the yellow separately indicating the Texan Sub-Region, the brown the Floridan Sub-Region.

In the above pages I have simply stated the facts now known regarding the actual distribution of our land shells, scarcely attempting to explain it. I will here venture to make a few suggestions on this subject.

Even at the present stage of our knowledge, we are justified in believing that North America has received a group of small species from the circumpolar regions. These species are common to the three continents, Europe, Asia, and America. A great duration of time has been required to effect their wide distribution over the continent, even into Mexico. I believe, therefore, that they are no recent acquisition to our fauna. They may even antedate the creation of our strictly American species.†

Again, in the Southern Region we have evidence of immigration from other faunas; Florida possessing West Indian and South American species, Texas many from Mexico. We have, however, at the same time, equal evidence of a distinct creation for a large portion of the fauna of our Southern Region, so peculiar is it to the region.

By a distinct creation only can I account for the origin of our peculiarly American fauna of the Eastern Province. I have traced it to

* On the map the dividing line between the Central and Eastern Provinces is carried more easterly, above Lat. 40°, than described in the text. This is done on account of the Central Province overlapping the Eastern at this point, as indicated by the distribution of *Patula strigosa*.

† Of these minute species common to the three continents, I find two at least, *Helix pulchella* and *Cionella subcylindrica*, giving somewhat similar proof of great antiquity by their distribution in Europe and Asia, and especially by their presence in Madeira.

Post-pleiocene times,* since when scarcely any change has occurred in the fauna.

Of the origin of the fauna of the Central Province, little can be said with our present knowledge. The same applies to the Pacific Province, though the peculiarity of its species surely indicates a distinct creation of its fauna.

Finally, we have in the list of American land shells several species, purely local in their distribution, imported through the more or less direct agency of man. Of these, *Helix aspersa* was no doubt introduced as an article of food by foreign residents of Charleston, S. C., and seems to have established a hold there.† *Zonites cellarius* was introduced by foreign shipping, probably around water-casks. It is also well known to have been introduced into other countries. The *Limaces* are found around human habitations; they seem to follow the English to all their colonies. The other foreign species mentioned on pp. 205, 213 have probably been introduced around the roots of plants, as have been other species which are from time to time sent me from greenhouses, gardens, etc. They are only local except *Helix hortensis*, which may have been accidentally introduced in some other manner,

* I suggested on p. 206 that the region of Ohio and Indiana was the point from whence the fauna was distributed. Another theory might suggest that the Cumberland Sub-Region was the point of origin of all the species, those still restricted to that sub-region not being adapted to the wider distribution which the other species have obtained. Any one familiar with the habits of snails is well aware how much they differ in this respect. Some are much more disposed to migrate than others. Thus, *Helix appressa* is content to remain within a radius of a few feet under a decaying log. *Helix thyroidus* is more restless, travels much, and climbs trees. *Helix nemoralis* has no local attachments, migrating far and wide. These facts I have verified in my own garden during many years. The *H. Nappressa* spoken of are descendants of Illinois specimens given me fifteen years ago by the lamented Kennicott.

† I have been asked what authority I have for this opinion, so think it worthy of statement that Charleston specimens belonging to the cabinet of the late General Totten still retain a strong odor of the garlic which seasoned them for the foreign palate. I have myself had specimens given me by French residents of the town where I reside, who had bought them as food in Philadelphia. The species has also been imported into Havana, Rio Janeiro, St. Iago, Chili, and other ports as an article of food. I received living specimens from a garden in Charleston, S. C., within the last twelve years, and in 1871, Professor Featherman sent me specimens from Baton Rouge.

since the discovery of America by Europeans, and owe its present distribution in the northeast to its being peculiarly adapted to colonization. I have elsewhere related my successful attempt to colonize the allied *H. nemoralis*.*

BURLINGTON, N. J., June, 1873.

* Before closing I will continue the note to p. 202, which suggests some of the changes which would be caused in the pulmonate fauna of Eastern North America by a subsidence in the continent of eight hundred feet. In the Southern Region the change would be still greater. All the species peculiar to it, catalogued on p. 213, would perish, excepting *Bulimulus alternatus*. This species would still be found in Kentucky, restricted to a small area; all record of its former wide distribution being at the same time destroyed.

The West Indian and South American species, catalogued on p. 214, would no longer be found on the North American Continent, nor would any record be preserved of the former connection of the regions. Indeed, no one would then suspect that the tropical genera *Glandina*, *Veronicella*, and *Cylindrella* had ever been represented on this continent.

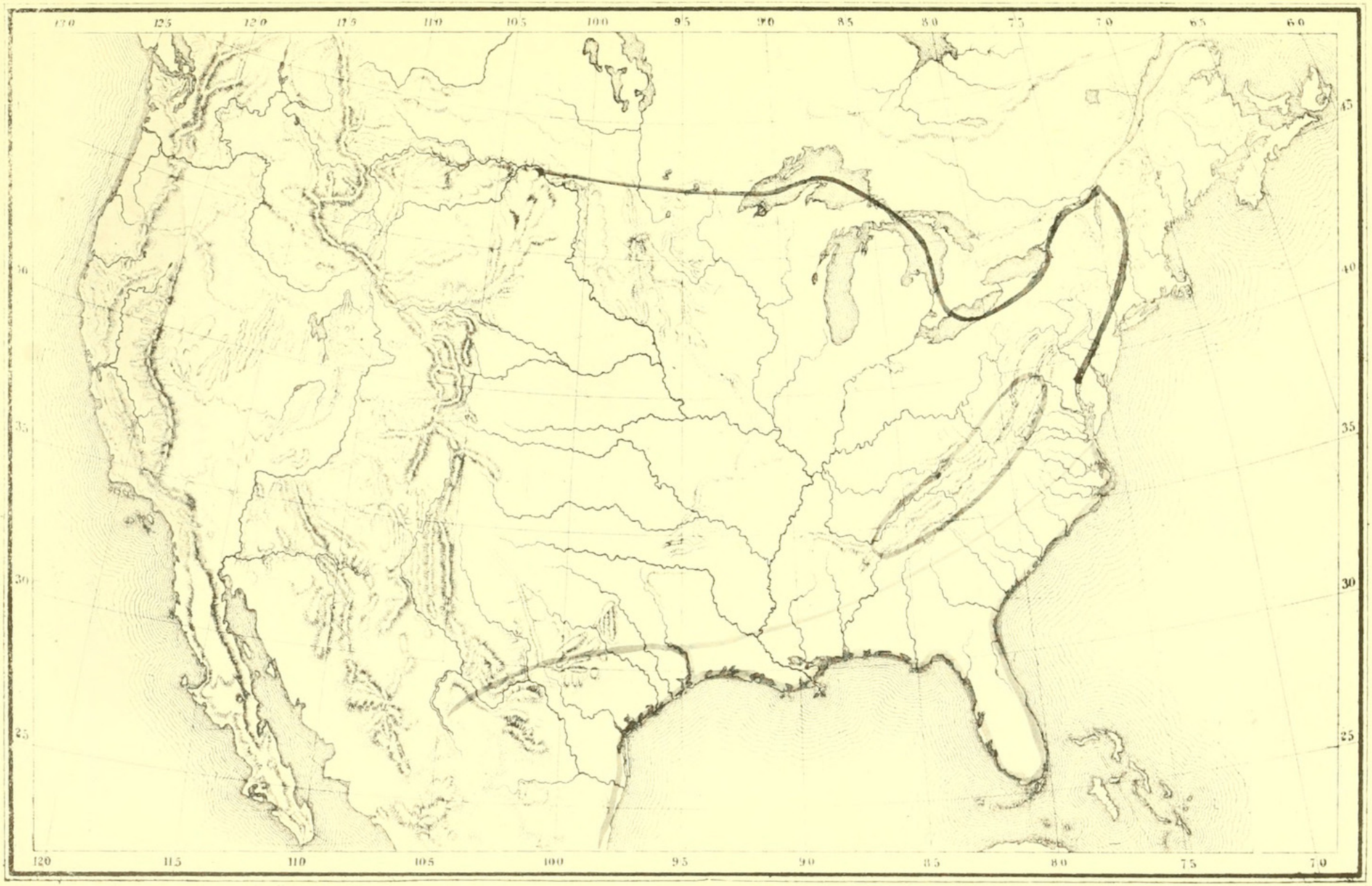
The West India Islands being much more widely separated from North America, the presence among them of the small American species (catalogued on p. 214) would be still more difficult to explain.

Again, the supposed subsidence would destroy most of the species peculiar to the Sub-Region of Texas (see p. 215), and remove the evidence of the present intermingling of the North American and Mexican faunas in that Sub-Region.

Another effect would be to remove from our reach all evidence of the origin of our species in Post-pleiocene days, the fossil deposits in the bluffs being rendered inaccessible. Thus one would not be able to have correct impressions of the origin and distribution of certain species. The non-pulmonate *Helicinæ* give the best instance of this. Finding *Helicina orbiculata* and *occulta* confined to the narrow limits of the Appalachian Island, one would have no reason to suspect their past history has been so much more interesting than that of many of the species of *Stenotrema*, etc., found with them, which never had had a larger distribution. It would be impossible to know that *Helicina orbiculata* and *occulta* flourished greatly in Post-pleiocene times; that later, one of them, *occulta*, became comparatively rare and restricted in range, while *orbiculata* became very numerous in individuals over a vast extent of territory; and finally, that our supposed subsidence gradually restricted them to the Appalachian Island.

This supposition of subsidence might be carried still further, till we should have in certain islands of the Appalachian chain the sole resting-places of the now widely distributed Eastern North American fauna. The more southern of these islands would alone retain the species of the present Cumberland Sub-Region, and thus be much richer in species than the more northern islands. On the other hand, these more northern islands would possess species derived from the present northern regions which would not be found in the southern islands.

Still more instructive is the supposition of a subsidence in Eastern North America which would leave above the level of the sea only two groups of islands formed by the White Mountains of New Hampshire, and Mount Mitchell and Black Mountain of North Carolina. On the latter we may suppose would be preserved all the species given in the lists on pp. 209, 210, 211. Of these species all would be peculiar to the island, except such as are named in the list on p. 208, which would all be found also in the White Mountains, where we should also find the following species peculiar to the islands, *Helix Sayii, dentifera, Vitrina limpida, Zonites milium, Binneyanus, ferreus, exiguus, multidentatus, Patula striatella, asteriscus, Pupa decora, Vertigo Gouldi, Bollesiana, simplex, Succinea Totteniana.* Of the former distribution of these species nothing could be known, but a former connection of the two groups of islands would be surely indicated by the presence of so large a proportion of species common to each. A former connection of the two groups of islands with Europe and Asia would be as surely indicated by the presence on each of *Zonites fulvus, nitidus, viridulus, Helix harpa, pulchella, Cionella subcylindrica,* and *Pupa muscorum.* Nor could it escape the attention of conchologists that these and other small species, *Z. arboreus,* &c. (see p. 204, note,) proved that a former connection must have existed between these groups of islands and the far-off Central and Pacific Provinces.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