MAP
of the
GEOGRAPHICAL DISTRIBUTION
OVER THE GLOBE
of the
BULIMI,
A GENUS OF TERRESTRIAL MOLLUSCA

BY LOVELL REEVE, F.L.S.

ARCTIC OCEAN
Spitsbergen
GREENLAND
GREENLAND SEA
Icy Cape
Arctic Circle
Iceland
England
SIBERIA
Finland
St Petersburg
NORTH AMERICA
Hudsons Bay
Newfoundland
BRITISH ISLES
EUROPEAN RUSSIA
ASIA
GERMANY
FRANCE
SPAIN
TURKEY
Black Sea
CAUCASUS
TARTARY
ASIA MINOR
Sicily
Candia
ALGERIA
PERSIA
CHINESE EMPIRE
THIBET
Himalaya Mts
NEPAUL
NORTH PACIFIC OCEAN
ATLANTIC OCEAN
NEW CALIFORNIA
TEXAS
ALABAMA
MEXICO
Canary Islands
Tropic of Cancer
Sandwich Is
WEST INDIES
GUATEMALA
HONDURAS
Cape de Verd Is
Gambia
Mascat
ARABIA
EGYPT
ARABIAN SEA
HINDOOSTAN
BIRMAH
COCHIN CHINA
Meia-shima I.
Formosa
Luzon
Philippine Is
Mindanao
NICARAGUA
Panama
NEW GRANADA
VENEZUELA
Trinidad
Orinoco River
Galapagos I.
ECUADOR
Amazon River
EQUATOR
Liberia
Cape Palmas
Prince I.
Gaboon R.
Ceylon
BORNEO
Celebes
NEW GUINEA
Equator
Equator
Marquesas Is
SOUTH AMERICA
PERNAMBUCO
BAHIA
PERU
Caravellas
Rio de Janeiro
I.d Solstice
St Helena
Leonda
Benguela
Zanzibar
Seychelles
INDIAN OCEAN
Mozambique
MADAGASCAR
Mauritius
Navigator Is
Friendly Is
Society Is
Tropic of Capricorn
Port Natal
Cape of Good Hope
AUSTRALIA
Sydney
N. Hebrides
Fegee I.
New Caledonia
Salemen Is
Timor
Java
Van Diemans Land
Macquarie I.
Kerguelen Is
Auckland
Falkland Is
Tierra del Fuego
Valparaiso
CHILE
BUENOS AYRES
SOUTH PACIFIC OCEAN
Antarctic Circle
South Victoria

TYPICAL PROVINCES OF DISTRIBUTION

VENEZUELAN	CAUCASIAN
BRAZILIAN	MALAYAN
CHILIAN	AFRICAN
BOLIVIAN	miscellaneous

Humboldt's Isothermal lines.

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XXII.—*On the Geographical Distribution of the* Bulimi, *a genus of terrestrial Mollusca, and on the modification of their Shell to the local physical conditions in which the species occur.* By Lovell Reeve, F.L.S. &c.

[With a Map.]

The *Bulimi* are distributed over the equatorial, tropical and warm temperate regions of the globe in assemblages of species, limited in their range, and of very distinct typical character; and being of sluggish habits with few means of transport, little migration occurs even where there are no such natural boundaries as seas, deserts, or mountain chains. Of the *Bulimi* known from all parts of the world, the localities of nearly 600 species are now well authenticated. They are all described and figured in the 'Conchologia Iconica'; most of them with the particular circumstances of habitation. Their area of geographical distribution lies between 40° S. and 35° N. in the new world, and between 42° S. and 52° to 55° N. in the old world;—that is, between the southern borders of Chili and Texas in the former, and between Van Diemen's Land and Germany, if not Sweden, in the latter. And there is no country within this area of which the genus of snails under consideration does not form part of the zoology. There is one abnormal species, *B. lubricus*, removed from the genus by British authors, which obtains a more northerly range and a greater elevation in both hemispheres.

Regarding the differences of form, composition and disposition of colour in the shell, the *Bulimi* are distributed over this area in seven provinces, comprising about forty typical assemblages of species. Of these three-fifths inhabit the western hemisphere, principally Central America, and two-fifths have a wider range and greater local variety of character, in conformity with the more varied arrangement of the land, in the eastern. Taking the size and substance of the shell at different elevations and in

different degrees of temperature, it may be remarked that the calcifying energies of the *Bulimi* are most strongly exerted in thickly wooded districts, in the midst of plenty of decaying vegetable matter, close and humid, with a mean heat of from 80° to 85°, among shady thickets or in ravines. Near the sea-level in thin calcareous soil, and in sandy plains, where the vegetation is scanty and parched, and in grassy savannahs, the shell is thin and often vividly coloured. In those species whose habit it is to burrow in the ground, the shell is mostly small, patternless, and of glassy tenuity, even in localities remote from each other and differing materially in physical character.

I. The Western Hemisphere.

The Western Hemisphere comprises four grand provinces of distribution, the Venezuelan, the Brazilian, the Chilian, and the Bolivian, and from these may be further distinguished the districts of the Gelepagos Islands and of the Great Antilles. The first province includes the countries of New Granada and Venezuela; the second comprises the empire of Brazil and Buenos Ayres; the third comprises Chili and West Peru; and the fourth province includes Bolivia and the Argentine Republic. About three hundred and fifty species are known.

1. *The Venezuelan Province.*

The highest condition of the genus is in intertropical America, which yields about one half of the number of species known from all parts of the world. In the luxuriant districts of New Granada and Venezuela, watered by the tributaries of the Magdalena and Orinoco rivers, with a temperature varying from 70° to 100° in the shade, about sixty species have been collected at different altitudes. On the mountain sides near the sea, away from the land breezes, with little vegetation, where the thermometer never falls below 80°, are a few species, *B. erectus, Cacticolus,* &c., of which the shell is extremely thin and sombre from the want of moisture for the animal, which is curiously spotted and painted, and attaches in clusters to the parched Cacti, eating into their fleshy substance. The animals of the beautifully variegated shells of the Philippine *Bulimi* are of a uniform dull gray colour. These contrasts between animal and shell are worth noting. Higher up on the mountains of Venezuela for the space of about 2000 feet, the country being still of a sandy and stony nature, with little vegetation except Cacti and other dry prickly shrubs, and a few trees in the ravines, the *Bulimi* are still comparatively small, but the shell is more brilliant in colour. *B. Curianensis, Knorri,* and *Studeri* are beautiful examples of this type,

of which the darker varieties inhabit the higher and woodier situations. They are rarely found at a greater elevation or in a lower temperature than about 76° within doors. Proceeding upwards on the mountains of Venezuela, the plants are now thicker, and give place to large trees with underwood of broad green leaves, enveloped in clouds and mists which occasion considerable humidity. In these situations at an elevation of from 4000 to 6000 feet are the richly-coloured *B. fulminans* and *Blainvilleanus*, and at a still greater altitude reaching to 8000 feet, with a proportionably lower temperature of from 65° to 70°, under decayed leaves in thick moist woods, in ravines and in crevices of the mountains, are the large stout dark-painted *B. Moritzianus, astrapoides, pardalis, Funckii*, &c., representing the most highly calcified condition of the genus hitherto discovered.

2. *The Brazilian Province.*

Passing in a south-easterly direction into the great territory of Brazil, we have no information of the presence of any typical assemblages of *Bulimi* until reaching the countries of Bahia and Minas Geräes. It can hardly be doubted, however, that in Guayana, Pará, and all that country constituting the great basin of the Amazon, many fine species occur, in addition to *B. Bensoni*, which belongs to the widely spread *B. zebra* type, as well as in Piauhy, Goyaz, and the more sterile parts of Pernambuco. From Bahia southwards to Rio Janeiro, the genus is represented by about sixty species, in six characteristic typical groups, extremely local, and of which the shell differs remarkably in its plan of convolution. In no part of the American continent is the theory of specific centres of creation, advocated by Professor E. Forbes, so distinctly recognized as in this area of ten degrees. On the Corcovado and other lofty mountains in the vicinity of Rio, in dense woods at an elevation of 1000 to 1500 feet, is a singular group, *B. Pantagruelinus, exesus, odontostoma, Pupoides*, &c., of which the shell differs from all other types of the new world, in having a number of tooth-like processes developed within the aperture of the last whorl on arriving at maturity. The only country in which this character again appears is in the centre of the old world, among the smaller and more temperate species of Syria and Hindoostan. In this part of Brazil we have also another type, peculiar to the locality, in which the last whorl is produced in front into a longitudinally angled channel, as in *B. goniostoma, egregius, angulatus, fusiformis*, &c. Upon the leaves of damp underwood, at an elevation of about 2000 feet, is another distinct and brilliantly coloured group, *B. multicolor, Miersii*, and the large *B. ovatus*, which inhabits also the neighbouring island of St. Catharina. In the lower grounds upon orange-trees and in the

coffee plantations about Tejuca at 1000 feet above the sea-level, the *Bulimi*, as in the lower parts of Venezuela, have their shells characteristic of less moisture and fewer opportunities of retirement. *B. papyraceus* may be quoted as an example. The more lofty and thickly wooded parts of Minas Geräes produce a type with shells of solid growth and intertropical brilliancy of colour, represented by *B. Milleri, bilabiatus, planidens, melanostoma*, &c. In the vicinity of Bahia is a group with shells of totally different construction and of lighter substance, *B. navicula, auris-leporis*, &c., in which the last whorl is peculiarly convoluted at a right angle with the axis of the spire. Lastly, at Caravelhas, below Bahia, and at the little island of Coxaprego, at the mouth of the Iguaripe river, is a remarkable type, represented by *B. calcareus, obeliscus, sylvaticus*, &c., of which the shell, presenting a singular contrast with the preceding group, is composed of a large number of whorls, drawn out into the elongated form of a *Turritella*. This partial grouping of opposite forms, within a comparatively limited area having few natural boundaries, will doubtless become broken up to a certain extent with the advancement of human progress. Already have the climate and natural vegetation of Rio been modified by the clearing away of the neighbouring forests of the Corcovado range of hills, which tends to reduce the humidity and other circumstances that combine to favour the growth and calcification of the terrestrial mollusca.

Owing probably to the recent geological disturbances that are supposed by Lyell, Darwin and others to have taken place in the southern extremity of the American continent, there are no typical provinces of *Bulimi* below Rio. The genus is represented by one or two scattered species in Buenos Ayres extending in the widely distributed *B. sporadicus* to the banks of the Rio Negro, but none are recorded from the sterile riverless plains of Patagonia. That the genus should be suddenly arrested at this point in a tropical condition, without any of the graduated states which abound in the north temperate countries of both hemispheres, is doubtless owing to the upraising of the land in this part of South America, which Mr. Darwin considers to have occurred within the period of the now-existing sea-shells. Mr. Cuming collected worn shells of *Voluta Brasiliana* (a species living on the shores of Buenos Ayres) in a bank of other dead shells fifty miles inland. The climate is many degrees warmer in Patagonia and Tierra del Fuego than in the same latitude of the northern hemisphere. "Evergreen trees," says Mr. Darwin, "flourish luxuriantly under it, humming-birds may be seen sucking the flowers, and parrots feeding on the seeds." Snails being of less fugitive character than birds, and offering fewer means of transport than plants, appear not to have migrated thither. The

sea which washes the shores of Patagonia is peopled with a fauna of more tropical character than the land, owing to the warmth of the great equatorial current, which flows southward along the eastern coast of South America, and causes a bend in the system of isothermal lines laid down by Humboldt of nearly ten degrees. A fine large richly painted Volute, *V. Magellanica*, in common use among the Patagonians as a drinking-cup, inhabits their shore abundantly. Yet the northern limit of this genus does not approach the Mediterranean nor any part of Europe. It is right however to add, that a species of *Cymba*, to which genus *V. Magellanica* is the nearest allied form of *Volute*, has been very recently dredged off Lisbon by Mr. McAndrew.

3. *The Chilian Province.*

Crossing to the west side of the American continent and returning northward, we are impressed with the marked difference between those on the west and those on the east side of the mountain chain of the Andes. In the sandy plains of Chili, where there is little moisture beyond that arising from the dews, the *Bulimi*, about thirty-five in number, are mostly small, with thin, often transparent shells, having little of colour or marking. Towards the mountains at the roots of shrubs, on dead trunks of trees or under Cacti, are several species distributed somewhat miscellaneously in respect of form, as *B. granulosus, erythrostoma, Pupiformis*, &c. Near the sea-shore they assume a more distinct typical character, of which the shell, *Succinea*-like, is widely inflated, and owing to the dry calcareous nature of the soil and absence of vegetation is extremely thin, brittle, and simply dark-speckled. The *B. Broderipii, punctulifer, rupicolus*, and *reflexus* are characteristic examples. Surrounded with few of the conditions which serve for the formation of shell, the calcifying functions of this group are but feebly exercised. They exist for many months together in the crevices of rocks in a state of torpidity, and are only roused during the excessive dews. "Wait till the dews come," said a Chilian to Mr. Cuming, "and they will all come to life again."

In the warmer, but still comparatively rainless district of Peru, the *Bulimi* have more brightly-coloured shells, with more variety of pattern. They are about as numerous in species as those of Chili, under as many types. In the more arid parts of Peru, upon the mountains, the shell is thin, as in *B. varians, tigris, lemniscatus*, and *tumidulus*, compared with those inhabiting more woody districts on the eastern side of the Andes. They have, moreover, a colder aspect than those of the same latitude in Brazil, on account of the more scanty nature of the vegetation, the lesser

humidity of the atmosphere, and the cold precipitated from the cold antarctic drift current which flows in a northerly direction along the western shores of South America nearly to the equator. The effect of moisture and consequent amount of decaying vegetable matter in promoting the formation of shell is curiously illustrated by the presence of a stout richly-coloured species of large size, *B. phasianellus*, on the rainy border of Peru, where they crawl up the stripped trees in great abundance; and by the *B. Tupacii*, dwelling on bushes and garden walls on the Bolivian side of the Andes at an elevation of 9000 feet, which has a robust dark-painted shell similar to those of the lofty Venezuelan type. *B. rosaceus*, which inhabits a wide range of country, extending from the environs of Valparaiso, near the sea, to Cocapata in Bolivia, crouches under stones in the sand in the first-named locality, and has a pale smooth calcareous shell. But in the woods of Cocapata, where it lives in more humid situations among the trunks of trees, the shell is larger, stouter, more richly coloured, and with more of epidermis. Thus we have the change which characterizes different species, presented in the same species under different conditions. Another remarkable instance is presented in *B. zebra*. This species inhabits an area of Central America enclosing Honduras, Nicaragua, the West Indies, and Pernambuco, reaching to the shores of Peru, and produces a shell varying so much in character according to the physical conditions under which it is formed, that it has been described as several species. The same has occurred with *B. regina*, which in its range from New Granada and Guayana to Bolivia and the interior of Peru, affects a condition partaking in each instance of the local conchological character of the country.

4. *The Bolivian Province.*

From Bolivia and the Argentine Republic about forty *Bulimi* are described, illustrative of six types. The large Brazilian *B. ovatus*, living near the coast, is here represented in the heart of the continent, at Santa Cruz, by the gigantic *B. maximus* and *Valenciennesii*, inhabiting the dense forests of the Cordilleras with *B. lacunosus* and a few other allied forms. Another type with shells of stout growth is represented by *B. Tupacii*, *thamnoicus*, and *inca*; and an extremely interesting form is presented in *B. onca*, found by M. D'Orbigny at the bottom of a deep ravine near Tutulima. A few species with delicately painted shells, constituting another group, inhabit the woods in the vicinity of Cochabamba, *B. linostoma*, *xanthostoma*, *fusoides*, &c.; and a characteristic group with shells of light structure, freely marked but not highly coloured, is typified by *B. pœcilus*, *hygrohylæus*, *marmarinas*, *orcades*, &c. The ground-burrowing species, with ex-

tremely thin shells devoid of colour or pattern, consist of *B. bacterionides, lichnorum, turritella,* &c. Two or three species have been collected on the mountains surrounding the Lake of Titicaca, which is itself 14,000 feet above the level of the sea. Of these *B. Pentlandi* and *Hamiltoni* may be quoted as examples. In the high lands of the Cordillera range, commencing at the Lake of Titicaca, passing along the region of medicinal barks, as laid down by Weddell, to Cuzco, Chachapoyas, and the Andes of Caxamarca, and extending across the equator by Quito, Bogota, and Merida, nearly to Caraccas, many fine species have been collected, but of too miscellaneous a variety of form to show any typical assemblages. From this extensive and little-explored region we have *B. labeo, Adamsoni, Thompsoni, rhodolarynx, Hartwegii, Alto-Peruvianus, alutaceus, Taylorianus, murrinus, Lobbii, Clausilioides,* and *columellaris,* singularly different from each other, and differing altogether from the *Bulimi* of Bolivia and La Plata. There is, however, one well-defined group inhabiting the southern extremity of the Cordillera range at Merida and Bogota, of which *B. Cathcartiæ, Veranyi, Succinoides* and *quadricolor* are characteristic examples. They have peculiarly inflated richly coloured shells, and are covered with a delicate hydrophanous epidermis disposed in hieroglyphic patterns after the manner of the Philippine *Bulimi.*

5. *Central America.*

Of the remaining *Bulimi* of the American continent, about ten species inhabit the central neck of land which comprises the provinces Veragua, Panama, Costa Rica, Nicaragua, Honduras and Guatemala. Fourteen species have been collected in the hilly parts of Mexico; and two or three species scattered in California, Texas, and Alabama constitute the northern limit of the genus in the new world. The *Bulimi* of Central America are very distinct from those of which we have been speaking hitherto. *B. Panamensis, vexillum, translucens* and *unicolor* from Panama, *B. corneus* from Real Llejo, *B. discrepans* from Conchagua, and *B. Hondurasanus* and *Dysoni* from Honduras, are all characterized by a thin transparent horny shell of the same type. They have little pattern or variety of colour, and live upon the trunks of trees or under fallen leaves. None of the South American types have any representatives in Central America. There is, however, a single species in Honduras, *B. Kieneri,* belonging to a singular *Cyclostoma*-like type, which belongs evidently to Jamaica, where it is represented by *B. Gossei, turricula, unicarinatus, cylindricus,* and *Guildingii.* In Mexico the *Bulimi* are more varied. Five species, *B. Mexicanus, serperastrus, livescens, Humboldtii* and *nitelinus,* in which the shell is of a light brittle structure, oblong

form and simply dark-banded, belong to a type quite peculiar to this locality, extending in *B. Californicus* to the opposite peninsula. At Vera Cruz, on the eastern side of Mexico, a Bolivian type appears in *B. Lattrei, Jonasi* and *fenestratus*. A very remarkable type is presented in the Mexican *B. Dombeyanus*, which is at present unique. *B. labiatus* and *Schiedianus*, which are almost colourless, partake of the typical character of *B. confinis* and *liquabilis* inhabiting Texas, and *B. dealbatus* inhabiting Alabama, which is the northern limit of the genus in the new world.

6. *Islands of the Western Hemisphere.*

The terrestrial conchology of the islands of the western hemisphere is for the most part typically distinct from that of the continent, and the more so in each particular group of islands in proportion to their distance from the main land. This receding gradation of types is distinctly shown in the *Bulimi* of the Great and Little Antilles. In the first group of islands this genus has but a meagre share in the conchology, which comprises more of *Cyclostomata*. In the latter group the *Bulimi*, passing southward, are gradually larger and more painted, and exhibit a relationship with those of the neighbouring continent. Jamaica, Cuba, and Tortola yield a few species of the *Cyclostoma* type, *B. Gossei, turricula*, &c., just spoken of as appearing at Honduras in *B. Kieneri*; but there are more of the ground-burrowing *Glandina* type, such as *B. subula, octonoides, Goodhalli*, and *pauperculus* inhabiting the savannahs. *B. immaculatus* is a rather large species, and *B. mirabilis*, remarkable for its squamate growth, is quite unique as a type. In Guadaloupe and Martinique, connecting the Leeward and Windward of the West India Islands, a few species occur with shells of darker and more solid growth, as *B. Guadaloupensis, Martinicensis* and *chrysalis*. In the principal islands of the Little Antilles approximating to the South American continent, the *Bulimi* increase in size and colouring, gliding most distinctly into the types of the Venezuelan province. The richly painted *B. fulminans* and *Blainvilleanus* of Merida are represented in the island of St. Vincent by *B. auris-Sileni*; the delicate *B. roseatus* and *xanthostoma* of Bogota by *B. stramineus* and *Vincentinus* in the same island; and *B. glaber*, a robust species of Trinidad, is represented in the nearest main land of Venezuela by *B. distortus* and *euryomphalus*, and in New Granada by *B. perdix*.

The Gelepagos Islands contribute about ten species of *Bulimus*, small in size and of a dusky hue, agreeing in this respect with what has been observed by Mr. Darwin in reference to the dusky colour of the birds and insects. *B. eschariferus* and *rugulosus* from Chatham Island, *B. ustulatus, nux*, and *unifasciatus* from Charles Island, *B. Jacobi* and *rugiferus* from Jacob Island, *B.*

calvus from James Island, and *B. Darwinii* and *sculpturatus*, of which the particular island has not been noted, are all typically distinct from the *Bulimi* of the neighbouring continent. A species has however been very recently discovered, *B. achatellinus*, partaking of the character of *Achatinella*, an allied genus of snails confined to some of the Polynesian Islands. The *Bulimi* of the Gelepagos Islands seem, nevertheless, to be purely aboriginal, living among dried tufts of grass, upon comparatively leafless bushes, or under detached pieces of lava, and presenting indications of the volcanic nature of the soil and desert character of the vegetation.

The Polynesian Islands have no *Bulimi* except one or two small transparent ground-burrowing species, *B. Antoni* and *Oparanus* from the island of Opara, *B. Tuckeri* from Hardy's Island, and *B. Sandwicensis* from the Sandwich Islands. Their absence is, however, compensated by the presence of two other genera of land snails which are not found anywhere else. In the Society Islands the *Bulimi* are represented by the *Partulæ*, and in the Marquesas, Friendly, Sandwich, and Navigators' Islands, by the *Achatinellæ*.

II. The Eastern Hemisphere.

The *Bulimi* of the eastern hemisphere are more partial in their character and distribution than those of the western, owing to there being less explored land within the parallels of latitude inclosing the conditions most favourable to their existence. In West Africa they are replaced by a tribe of large *Achatinæ*. But in the localities which they inhabit within this intertropical area, comprising chiefly the islands of the Indian Archipelago, they are more numerous in species in proportion to the extent of land. The *Bulimi* of the old world have a wider range in the warm temperate regions, and the geographical position of the genus is more insular than continental. As many species have been collected in the Philippine Islands alone as in the whole extent of continent between Sweden and Cochin China. The eastern *Bulimi*, comprising about two hundred and fifty species, present three grand typical provinces of distribution, which may be termed the Caucasian, the Malayan, and the African. The limits of these provinces are well-marked, and they possess no species in common. The species are all distinct from those of the western hemisphere.

1. *The Caucasian Province.*

The Caucasian province has its centre in Asia Minor, and occupies an area extending west and east over the southern countries of Europe and Asia to the opposite shores of North Africa.

At the eastern limit of this province in the British Isles and at the western limit in the Meia-co-shimah Isles, the shell is of the same form, substance and colour. The shell of the Caucasian *Bulimus* is small, mostly white or dusky brown, sometimes convoluted sinistrally, and partakes very much of the character of *Pupa*, which is the predominant genus of this district. At the north-western extremity of the Caucasian province the genus is represented in the British Isles, Germany, France, Spain, and Portugal by the small *B. obscurus*, *montanus* and *acutus*. The first of these extends to South Sweden, fifteen to twenty degrees nearer the Arctic Circle than in the new world, agreeably with the curve of Humboldt's isothermal lines in that direction, and confirms the warmer comparative temperature of this portion of the eastern hemisphere. In *B. ventrosus* and *decollatus* the genus obtains a more southern range, extending into Sicily and the Canary Islands. The *Bulimi* of the Canary Islands are, however, for the most part indigenous. Of the following species inhabiting this group, *B. variatus*, *Moquinianus*, *obesatus*, *bæticatus*, *Bertheloti*, *subdiaphanus*, only the last is found in any other locality, the Cape de Verd Islands. No Canary Island *Bulimus* has been collected in Portugal, Spain or Sicily, but a species has been found to range along with *B. barbarus*, *rupestris*, and *Bergeri* over Greece and the eastern islands of the Mediterranean to Algeria and the borders of Egypt. *B. detritus*, *subtilis*, and *quinquedentatus* may be noted as belonging more especially to Austria and Central Europe, and *B. Varnensis*, *Frivaldskyi*, and *Chersonesicus* to Turkey and the Crimea. Towards the vicinity of the Caucasus the *Bulimi* are more numerous, of larger and more solid growth and more divided into groups. Owing to the dry juiceless thorny character of the vegetation, their habits differ from those of the humid and woody countries of intertropical America. Their shells are comparatively small with little colouring matter or epidermis, and they live under stones or blocks of wood, or suspended for a long season in a state of torpidity from the shrubs. The difference between the shell of the Caucasian and that of the Malayan or Venezuelan *Bulimi* is very characteristic of the physical conditions with which the animal is surrounded in each instance. *B. labrosus*, *labiosus*, *Alepi*, *Syriacus*, and *Ehrenbergi* are true Caucasian types. In *B. Sprattii* and *Lycicus* the shell has a light and ventricose growth, but in *B. spoliatus*, *zebriolus*, and *Tournefortianus* it has an elongated *Pupa*-like form.

Passing the south-western countries of Asia we find no species of *Bulimus* recorded from any locality between Syria and Afghanistan. Of the terrestrial conchology of Persia, Tartary and Beloochistan, nothing is at present known, and very little of that

of China. South of Syria a natural boundary is imposed to the range of the genus in that direction by the rainless and riverless deserts of Arabia. A few species make their appearance in the more fertile parts near the Gulf of Bab-el-mandeb and the Indian Ocean. *B. latireflexus*, a fine species inhabiting the vicinity of Muskat on the Gulf of Oman, has a polished shell of solid stony composition, without colour or marking, of precisely the same type as *B. labiosus* and *labrosus* of Asia Minor. *B. fragosus* and *Forskalii* inhabiting Yemen, also patternless, assimilate to the tumid tribe of *Pupæ* of Asia Minor. Abyssinia and the neighbouring island of Socotra, marking the eastern boundary of the Caucasian province, contribute two species from each locality, one of which species in both instances belongs to an Indian type, the other being remote from it. *B. Olivieri* of Abyssinia has an inflated shell with a dark fibrous epidermis very distinct in character from any Asiatic or European species, while *B. Abyssinicus* from the same locality has been collected also in Central India, north of the river Nerbudda. It is allied in form with *B. Jerdoni* from the hilly districts of the Deccan peninsula, and both species agree in typical character with *B. fragosus* of Arabia. *B. Socotrensis*, inhabiting the island of Socotra, off Cape Guadafui, has a peculiar little solid pea-shaped shell unique as a type; but associated with it in the same locality is an oblong cylindrical form, *B. contiguus*, belonging to a type of Hindoostan, represented by *B. pullus* inhabiting the environs of Delhi and Bundelkhund and extending into the Gangetic plains.

In the south-western countries of Asia the genus is very meagrely represented, but the species are peculiar in their circumstances of habitation. Two of comparatively large size occur on the hills of Afghanistan, *B. Griffithsii* and *eremita*, with opake colourless shells partaking of the Syrian type. From the whole of Hindoostan, including the Himalaya range, the Punjab, Scinde, Nepaul, Bhotan, Assam, the Deccan and Carnatic, only five-and-twenty species have been collected, limited apparently in number of individuals. In the plains watered by the numerous branches of the Ganges, with a temperature varying in the season of the hot winds from 85° to 90° at night, to 130° or 140° in the sun, the *Bulimi* are scattered and of miscellaneous character. On the wooded hills rising into a moist and cooler atmosphere they are more abundant. *B. rufistrigatus* at an elevation of 4000 feet has a fulvous horny oblong shell. *B. cænopictus* and *tutulus* inhabiting a lower level are minute delicate brown species, the latter being convoluted in the form of a rounded *Cyclostoma*. *B. pullus* is a light cylindrical form, *B. cereus* and *gracilis* are thin horny species, and *B. punctatus*, *Bontiæ*, and *Bengalensis* have light inflated shells of a type altogether different. The most

characteristic *Bulimi* inhabiting this part of Asia are those of the Himalaya range, *B. Kunawurensis, pretiosus, vibex, nivicola, cælebs,* and *arcuatus*. Their shells are of a fulvous brown colour, mostly streaked with opake white marks, all of one type, distinct from the Syrian, but sufficiently allied to come into the same province of distribution. Occupying a loftier situation than the species before mentioned, they have, as in Venezuela, stouter shells, but are still comparatively small and sombre. On the mountain slopes, where the flora, represented by the rhododendron and juniper, is of a subarctic character, the genus inhabits a much colder temperature in elevation than it reaches in either hemisphere in latitude. Two species, *B. arcuatus* and *nivicola*, are found in the Liti Pass at an elevation of 14,000 feet on juniper bushes among patches of snow at the hottest period of the year. This is the only locality in which the genus approaches the snow-line. The physical conditions of India below the Emodic or Alpine region of vegetation are not calculated to favour the growth of *Bulimi*. In the plains there is a scarcity of wood and forest, such as we have noticed to serve so materially for the production of these snails in South America; and the burning of the thickets in the hill countries for the pasturage of cattle, offers the same obstacles to their growth and increase as the clearing away of the virgin forests in Brazil.

2. *The Malayan Province.*

The Malayan province of the genus, which comprises the islands of the Indian Archipelago, commences on the south-western corner of the Asiatic continent, where it is represented at Burmah by *B. Sylheticus* and in Siam by *B. atricallosus*. These species are of a totally different type from any of the *Bulimi* of Hindoostan, and agree precisely with that characteristic Malayan type which appears at Java, Timor, Celebes and Amboyna in *B. citrinus, lævus, contusus, chloris* and *sinistralis*, at Borneo in *B. Adamsii*, at Ceylon in *B. Ceylanicus*, and at Mindanao, the most southern of the Philippine Islands, in *B. maculiferus*. *B. fulguratus* and *malleatus*, having an inflated shell with a winding plait upon the columella, represent a type peculiar to the Feejee Islands. *B. miltocheilus*, with a wax-like fusiform shell and brilliant vermilion lip, from Christoval Island, one of the Solomon's Group, is unique as a type. *B. fibratus* and *Caledonicus* with large robust shells of dark chestnut-brown colour, red internally, represent another very distinct type in the island of New Caledonia, but this appears again twelve degrees further south at Auckland, North Island of New Zealand, in the only species inhabiting that group, *B. Shongii*. It is worthy of notice, that this large stout tropical-looking *Bulimus* is under the same

latitude of the eastern hemisphere which is characterized in the western hemisphere by the delicate species of the dry sandy countries of Chili and Buenos Ayres.

The *Bulimi* of the Philippine Islands, which are very numerous and of large size, belong chiefly to one type, represented by *B. pythogaster, bicoloratus, lignarius, fulgetrum, nimbosus,* and others. The shell of this type is not so much distinguished by colour, as by the presence of a double membranous epidermis, to which the different species are indebted for their characteristic patterns. *B. Cumingii, Leaii,* and a few others belong to another type of which the shell is inflated, and mostly shining white with only a very slight single epidermis. About eighty species of *Bulimus* have been collected in the twenty-two islands of the Philippine group, all extremely local in their range of habitation. With the exception of about half a dozen out of eighty, each species is confined to its particular island. The equable climate of these islands, the excessive rains, and woody character of the vegetation combine materially to favour the growth of snails. They live some on the branches of the trees and in shady recesses, and others among light thickets on the outskirts of the woods. The large species are strictly arboreal, and deposit their eggs standing on end in parallel rows upon a leaf. The transparent horny ground-burrowing type which appears at Hindoostan in *B. cereus* and *gracilis,* and at Java in *B. Achatinaceus,* is here represented by *B. elongatulus* and *Panayensis.*

The only species collected in China are *B. decorticatus* belonging to the ground type, which is universal, and *B. Cantori,* from the environs of Nanking. They belong to the Caucasian type, which reaches the islands of Ty-pin-san and Koo-Kien-san of the Meia-co-shimah group of the Yellow Sea in *B. Anglicoides* found under decayed leaves among the loose stones which surround the tombs.

Of the *Bulimi* of Australia little is at present known. One species, *B. atomatus,* with a large dark-coloured inflated shell, has been collected at Port Macquarrie, one small species, *B. trilineatus,* at Port King George, and two, *B. Kingii* and *inflatus,* of which the precise locality is unknown. Two species with thin dusky shells, *B. melo* and *Dufresnii,* inhabiting Van Diemen's Land, constitute the southern limit of the genus in the eastern hemisphere.

3. *The African Province.*

The African province includes all that explored portion of the continent below Senegal on the west side, and Zanzibar, including the islands of Mauritius and Madagascar, on the east. In the intertropical area along the west coast of Africa, extending from latitude 15° S. to 15° N., the *Bulimi* are replaced in great mea-

sure by a group of large *Achatinæ*, which inhabit principally the hot and swampy districts on the banks of the Gambia, Nun, Gaboon and Niger rivers, and reach in a modified form to the sandy plains of Loanda. The shells are large, inflated, and richly dark-painted, and the shells of the few *Bulimi* that are associated with them belong to the same characteristic type. The two genera meet at this point. *Bulimus torridus* of Liberia and *Achatina Saulcydi* belong to the same natural type, notwithstanding that they are referred to different genera. *B. Adansoni, Africanus, tenebricus, turbinatus, flammeus, Numidicus,* and *interstinctus,* belong also to the *Achatina* type. *B. neuricus, Guineensis,* and *vivipara* are three fragile species of different habits from the same country, and another type is presented in *B. tumefactus* and *pemphigodes* with peculiarly globose inflated shells. As an instance of the mingling of types on the confines of the great provinces of distribution which meet in North Africa, it may be remarked that *B. Ruppellianus* inhabiting the eastern confines belongs to this *Achatina* type, and *B. reticulatus* inhabiting the western belongs to the Syrian *Bulimus* type, which is exactly the reverse of the general typical character of the *Bulimi* in these localities. *B. Downsii,* found abundantly at Princes Island off the coast of Guinea, inhabits also the nearest main land. At St. Helena a small brown species is found, *B. Helena*; and in the more elevated parts of the island, in an apparently semifossil state, the remains of an extinct type, *B. aurisvulpinæ,* are found. Mr. Darwin, who observed this well-known species at St. Helena imbedded in the soil, attributes the extinction of it to some recent geological disturbances, which caused the entire destruction of the woods and consequent loss of food and shelter to the snails.

Nothing is known of the *Bulimi* of Africa, south of the tropics, excepting those described by Dr. Krauss from the neighbourhood of Natal. Eight species collected in this part are of very miscellaneous character, but typically distinct from those of the west coast. *B. Natalensis, conulus,* and *spadiceus* are thin and globosely convoluted, *B. Burchellii* and *meridionalis* are of light ovate form, and *B. linearis* and *turræformis* are elongated. They are all small. A very remarkable species has, however, been discovered in this locality, *B. Kraussii,* nearly equal in size to the largest *Bulimus* of tropical America and as brilliant in colour. From Mozambique we have but one small light species, *B. Mozambicensis.* In Madagascar are two species of large size and elongated form, *B. clavator* and *obtusatus,* differing essentially from any of the continental types; and in the Seychelle Islands are two, *B. fulvicans* and *velutinus,* partaking in some measure of the smaller Natal species. In Mauritius there is only one small ground species, *B. clavulinus.*

Western Hemisphere.

General Localities.	Venezuelan Province.	Brazilian Province.	Chilian Province.	Bolivian Province.	*Miscellaneous.*	Western Hemisphere.
Venezuela and New Granada	62	..	..	..	..	62
Brazil and Buenos Ayres ..	..	70	..	..	..	70
Chili	..	..	19	..	..	19
Peru	..	..	34	..	..	34
Ecuador and Alto-Peru....	..	..	..	..	26	26
Bolivia	..	..	..	42	..	42
Central America	..	..	..	..	17	17
Mexico	..	..	..	..	17	17
Honduras	..	..	..	..	4	4
Texas and Alabama	..	..	..	..	4	4
West Indies	..	..	..	..	34	34
Gelepagos Islands	..	..	..	..	10	10
Hardy and Opara Islands..	..	..	..	..	3	3
	62	70	53	42	115	342

Eastern Hemisphere.

General Localities.	Caucasian Province.	Malayan Province.	African Province.	*Miscellaneous.*	Eastern Hemisphere.
British Isles and Southern Europe	9	..	..	..	9
Greece, Syria, and Asia Minor	32	..	..	..	32
Sicily, Canary and De Verd Islands	10	..	..	..	10
Arabia and Abyssinia	10	..	..	..	10
Tartary and China	4	..	..	..	4
Hindoostan	30	..	..	..	30
Burmah and Siam	..	2	..	..	2
Borneo, Java, and Molucca Islands	..	10	..	..	10
Philippine Islands.....	..	83	..	..	83
North Africa	3	..	..	..	3
West Africa	..	..	17	..	17
East Africa and Madagascar	..	..	18	..	18
St. Helena.....	..	..	..	2	2
New Zealand	..	..	..	1	1
New Caledonia	..	..	..	3	3
Feejee Islands	..	..	..	2	2
New Holland and Solomon's Group	..	..	..	6	6
Van Diemen's Land	..	..	..	2	2
	98	95	35	16	244