On the classification of Mammalia / by Charles Girard.

8. On the Classification of Mammalia. By Charles Girard, of Washington.

I.

The limits of the class of Mammalia were not clearly understood by the earlier naturalists. Some groups, which in former times were referred to other classes (as Cetacea and Bats), have successively been brought into it. None, however, originally placed in this class have ever required removal elsewhere. Thus the progressive investigations has always increased the number of the representatives of this class.

At the present day, we may safely say that we know all the essential groups of the class of Mammalia, the actual limits of which are acknowledged by every naturalist. Indeed, we must expect many additional species and genera which time and labor will bring to light, either in a fossil state from various depths in the strata which constitute the solid crust of our globe, or else from its actual surface, and belonging to the living fauna contemporary with the human races. Such additions are not expected to change or modify the boundaries of the class, though they may have some importance in the subdivisions and methodical arrangement of the minor groups.

The division of the class into secondary or minor groups, the relationship and subordination of the latter, have attracted the attention of all general writers on zoology. Almost every one has attempted a classification in accordance with the value attributed to one series of characters, rather than to another.

The most ancient authors seem to have occupied themselves but little with zoological characters : hence the subdivisions which they establish among Mammalia are based upon their mode of life, or the elements in which they live.

Next we see the subdivisions based upon external characters, the most striking being selected, such as the locomotive members.

All this prior to the eighteenth century.

Towards the end of that very century, however, comparative anatomy started as a science ; and at the beginning of the nineteenth, it introduced an entirely new method of classification. Systematic zoology underwent a metamorphosis.

The first half of the present century had not yet elapsed, when another science grew up with rapid steps, claiming her share in the

question of the natural classification of the animal kingdom : we allude to embryology. The formation of the young mammal, its genesis, its development prior to the period when it makes its first appearance in the world, if not entirely unveiled yet, are no longer mysterious, and their bearing upon systematic zoology is universally felt.

Palæontological data are not less important in arriving at a natural classification, than those derived from either comparative anatomy or embryology ; and indeed palæontology, comparative anatomy and embryology, hold an equal rank in respect to zoology.

As investigations progress in these fields of researches, new light is daily thrown on some obscure points, and difficult questions are thus elucidated ; but as yet, no methodical arrangement of the class of Mammalia has been universally adopted : there is still as much diversity of opinion, and perhaps even more, at the present time, than in the two past centuries, although as a whole our views on the subject have been improved upon those of our ancestors.

II.

In order to render more tangible our thoughts on the subordination of the various groups which constitute the class of Mammalia, we have prepared the accompanying plate, which we shall now examine.

The orders *Edentata* and *Marsupialia* are considered as the trunks of the class : these two groups, we place on the same level. They constitute the foundation, the bottom of the class, and accordingly are the lowest of all.

The trunk of Edentata sends out three diverging stems, the *Monotremata*, the *Edentata* proper, and the *Tardigrada** : an herbivorous stem (*Tardigrada* s. *Gravigrada*), an insectivorous stem (*Edentata* proper), and a carnivorous stem (*Monotremata*). The carnivorism in the trunk of Edentata is of the lowest grade, and subordinated ; as the carnivorous propensities only attack invertebrates, that is to say, animals of a much inferior rank, comparatively very weak and defenceless.

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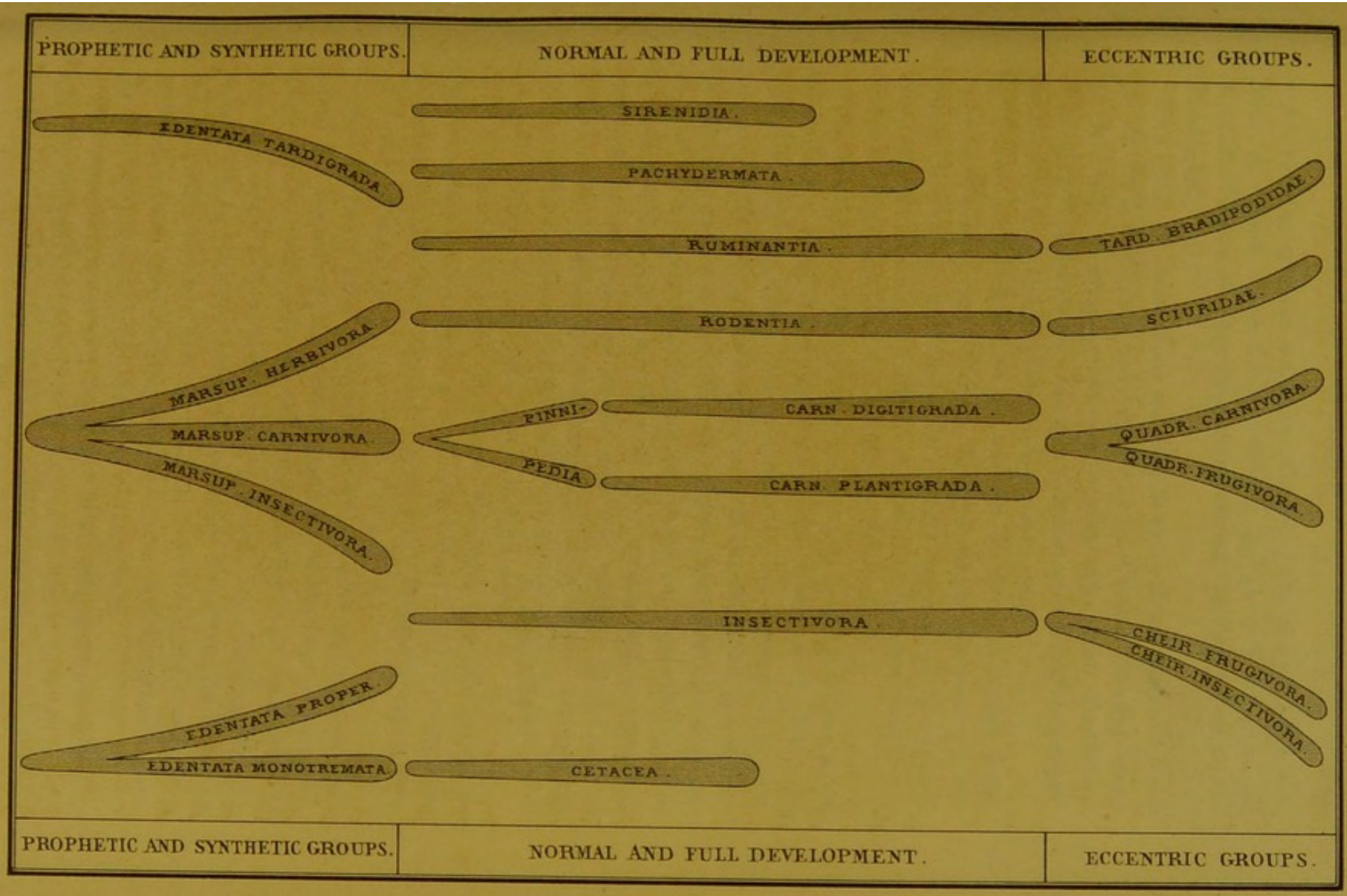
* The graphic representation on a plane surface has caused the stem of Tardigrada to be separated from its trunk ; but in bringing into contact both edges of the plate, we would obtain a figure similar to that of Marsupialia. Instead of a flattened surface, we want an ideal cone for both trunks.

IDEAL GRADATION OF THE CLASS OF MAMMALIA.



Above Monotremata we place *Cetacea* (whales and dolphins); Edentata proper, above the *Insectivora;* and above Tardigrada, the *Sirenidia*, or so-called herbivorous cetaceans, the *Pachydermata* and *Ruminantia.*

The trunk of Marsupialia exhibits likewise three stems, an *herbivorous*, an *insectivorous* and a *carnivorous.* Above which we have: the *Rodentia*, continuing the herbivorous stem; the *Insectivora*, continuing the insectivorous stem in common with Edentata proper; and *Carnivora*, continuing the carnivorous stem.

Thus above Edentata and Marsupialia, we have, on another level: *Cetacea, Sirenidia* and *Walrus, Pachydermata, Ruminantia, Rodentia, Insectivora* and *Carnivora;* that is to say, all the normal types which represent the full development of the class as synthetically combined in Edentata and Marsupialia below.

The fact that Insectivora are foreshadowed both by Edentata and Marsupialia, shows that there exists a close connection between the two trunks of the class. The insectivorism is intermediate in rank between herbivorism and carnivorism; it is of a higher grade than the former, and of a lower than the latter. The predominating feature of the trunk of Edentata consists in the vegetable diet, and in the want of a complete set of teeth; the predominating feature of the trunk of Marsupialia, on the contrary, consists in the animal diet, and the possession of a complete set of teeth. Accordingly there can be no doubt that Edentata are lower in grade than Marsupialia: they are the lowest grade in their class.

It will be obvious, also, that here Edentata rank the lowest in grade amongst the normal groups of the class; still showing that Edentata are inferior to Marsupialia, the latter foreshadowing groups of a marked superiority.

Now there are other groups which we place on still another level above the normal types, although not of an absolute superiority. Their place can be nowhere else; their history must follow that of the normal types from which they proceed: the *Bradipodidæ* (or sloths), arising from the herbivorous stem of Edentata; the *Sciuridæ* (or squirrels), arising from the stem of Rodentia; the *Cheiroptera* (or bats), arising from the stem of Insectivora; and the *Quadrumana* (or monkeys), arising from the stem of Carnivora.

We consider these as so many shoots of the mammalian tree, which went beyond the vital sphere of activity of the class; in other words, deviations from the normal development of the class.

III.

§ 1. Let us return now to some of the groups mapped down on our chart of the ideal gradation, and state in a very brief manner their most striking zoological features and relationships.

To begin with *Edentata*, which we concluded were the lowest of the class: when looking at those creatures amidst the other groups, we cannot help being strangely struck by their singular physiognomy, and the still more astonishing association of characters, which appear sometimes rather borrowed from other classes, than as belonging to that of Mammalia. We need only call to mind the water-mole (*Ornithorhynchus*) of New-Holland, the pangolins (*Manis*) of Asia and Africa, the anteater (*Myrmecophaga*) and armadillos (*Dasypus*) of South America, the aard-vark (*Orycteropus*) of the Cape of Good Hope, and the sloths of tropical America, which constitute the three orders *Monotremata*, *Edentata* proper, and *Tardigrada*, the one as strange as the other.

The Monotremata exhibit the lowest grade of mammalian organization. They are ovoviviparous; the young are without uterian connection with the mother, but they are suckled by the latter. In that respect they approach nearest to birds and reptiles; the structure of their sternum and shoulder, also, presents a great resemblance to the same parts in lizards and icthyosauri. Their position at the bottom of the order of Edentata is justified by the fact that one genus (*Echidna*) is completely deprived of teeth, whilst the other (*Ornithorhynchus*) possesses but a few insignificant ones. These two genera, which constitute by themselves the whole order, may just as well constitute two families, so wide are the differences in their general appearance and structure.

The Edentata proper constitute a group exceedingly remarkable, composed of a few genera likewise very strange in their characters, strange in their external features, strange in all their relations. The differences amongst these genera are so great that they have been made the types of as many families by systematic writers, and we believe with great propriety. The absence of teeth is the only character by which they are united, although this character is not absolute, inasmuch as grinding teeth in a very rudimentary state are observed in some few: the front teeth or incisors—those never exist in Edentata. Edentata moreover are provided with strong nails or claws to the four locomotory extremities.

Each of the types in Edentata, by its strange appearance, recals to mind another order of things, another physical period in the earth's history, of which they are mere reminiscences.

The Tardigrada divide into two groups, one completely extinct, the remains of which are found in the tertiary deposits of South America chiefly, the *Tardigrada gravigrada* or *Megatheridæ;* and another exclusively composed of living representatives, the *Tardigrada bradipodida* or sloths of Central and South America.

§ 2. The order *Marsupialia* is another combination into one group of strange forms and strange characters, quite as diversified and heterogeneous as in the Edentata, although Marsupialia seem cast upon a more uniform external mould. The great diversity resides in the physiognomy, and in the structure of the teeth.

In Edentata, we have seen the dentition so defective, that in several cases teeth were entirely absent. Here in Marsupialia the dentition is greatly developed, becomes a permanent character, and requires a contrasting importance. The incisors, it is true, are nowhere six in each jaw, which is the normal number; showing that at the outset the number was of a subordinate value, as well as the relative signification of the different kind of teeth. Nevertheless it can be distinctly shown that the three orders following, Rodentia, Insectivora and Carnivora, are synthetically combined and foreshadowed in the group of Marsupialia, which, when considered zoologically in itself, cannot but strike any one as an odd group standing isolated in the actual creation.

§ 3. The order of *Cetacea*, the lowest amongst the normal groups, may be subdivided into three families. The first and lowest, the family of *Balænidæ*, is characterized by the absence of teeth, or, if not entirely absent, they have no function. These are the *toothless* or *edentated cetaceans*, reminding us of the order of Edentata proper, our second prophetic type. The second family, that of *Physeteridæ*, exhibits well developed teeth on the lower jaw, and rudimentary ones on the upper : the *subdentated cetaceans* of the authors*. The

* Physeteridæ, or sperm-whales, are more nearly allied to dolphins than to whales, if we take into consideration the structure of the whole skeleton. We might even say that Physeteridæ are gigantic dolphins in which the development of teeth has stopped, and the body increased beyond all proportion. That colossal mass which sperm-whales partake with the whales proper, is of an incontestible inferiority, as it is unfit for graceful movements; but, on the other hand, the

third family, that of *Delphinidæ*, seems to complete the progressive series in the development of teeth; for the latter exist here on both jaws, whence the name of *ambidentated cetaceans*. The fourth family, that of *Heterodontidæ*, includes the narwhale or *predentated cetaceans*, and some other types in which the dentition is losing both its shape and its function. The *Monodon* (narwhale) is closely allied to *Phocæna* (porpoise), whilst *Hyperoodon* comes nearer to *Delphinus*. The other genera are deviations or reminiscences of the other families. Heterodonts, then, must follow the dolphins in a natural and serial classification. The order of Cetacea begins with the whales, and closes with heterodonts; the real superior groups are those placed in the middle, the Delphinidæ, which represent the normal cetacean type. They are the smallest of the order, and possess two fresh-water representatives, one closely allied to dolphins proper, the second bearing some far relations to Physeteridæ (sperm-whale), and to the genus Hyperoodon of the heterodonts family.

The morphology of the teeth in Cetacea is very interesting, and instructive in a philosophic point of view, when the relationships of this order with the Edentata are well understood. In the lowest type, teeth remain undeveloped; in the highest, they cover the whole surface of both jaws, but are of one kind: incisors, canines and grinding teeth are not known amongst cetaceans. This fact alone would ascribe to them an inferior rank amongst the normal groups of the class.

§ 4. The affinities of the so-called herbivorous cetaceans, or Sirenidæ, with pachyderms, have been alluded to by several authors. In 1834 Fred. Cuvier* wrote the following remarkable sentence: "The group of herbivorous cetaceans, composed of genera intimately connected together, are related to the pachyderms by the manati." And farther on (page 6) he remarks that they come nearer to pachyderms than to cetaceans. In 1838 they were definitively removed from the Cetacea, and actually placed amongst Pachydermata†. Upon this point, every naturalist now agrees. Sirenidæ are the lowest grade among pachyderms: even if considered as parallel

material strength is developed, and the muscular power increased to harmonize with the immensity of the element in which they live. Balænidæ, the lowest of the order, are likewise amongst the largest.

* Histoire Naturelle des Cétacés, p. 34.

† Owen, in Proceed. Zool. Soc., London.

to pachyderms, they still must rank lower in a natural classification. They are aquatic, provided only with the anterior limbs constructed for swimming. Unlike the cetacea, they live near the land, and may occasionally creep along a beach ; undoubtedly representing a higher step in the class, and an approximation towards the subaquatic Hippopotamus, which, together with the tapir, show intimate relation with the manati and dugong. The Dinotherium, and other fossil representatives of the group of Sirenidia, seem to synthetise the living genera of their groups together with both the proboscidian pachyderms and the ruminants. This synthesis, however, cannot yet be fully understood. The earth's crust has not yet yielded all the data by which alone we delineate the history of the pachyderms and allied groups from their cradle up to our days.

Amongst the living genera, we observe the following particulars : The *Manati*, when young, have on the lower jaw two small incisors directed forwards and downwards, reminding us of the tusks in Dinotherium. The presence of tusks, therefore, assigns to the latter a lower position. In *Halicore*, tusks exist on the upper jaw, as in the elephant, with which the genus *Rytina* seems also related by its teeth, although completely deprived of tusk of any kind.

§ 5. The position of the *Walrus* is between Sirenidia and Pachydermata ; they belong to the pachydermic order by structural evidences, and bear only analogies to the seals. They constitute a small group whose distinctive features from Manati consist in the presence of four locomotive members ; and from the other pachyderms, in having these four locomotive members adapted for aquatic habits.

§ 6. The order of *Pachydermata* is the least understood of all, on the very ground that its history belongs chiefly to the past ; and since Sirenidia and Trichechidæ (walrus) are referred to the same group, it becomes difficult to determine the relationships between the living and the extinct representatives in order to establish a graduated series.

We are satisfied of the existence of two progressive series in the pachydermic groups, in the following way :

WITHOUT PROBOSCIS.	PROBOSCIDIANS.
EQUIDÆ,	ELEPHANTIDÆ,
SUIDÆ,	MASTODONTIDÆ,
HYRACIDÆ,	RYTINIDÆ,
RHINOCEROTIDÆ,	HALICHORIDÆ,
HIPPOPOTAMIDÆ,	MANATIDÆ,
TRICHECHIDÆ,	DINOTHERIDÆ,

ANOPLOTHERIDÆ,
PALÆOTHERIDÆ.

At the bottom of the order, the extinct Palæotherium and Anoplotherium : on one side the proboscidians, and on the other the families which have no proboscis. The proboscidians are relatively inferior to nonproboscidians, inasmuch as they are *edentata* in the general sense of the word : grinding teeth and tusks alone exist. In the nonproboscidians the dental system acquires a great development, the greatest to be observed in the edentated trunk ; but as this development is an excessive effort, and thus brought the group beyond its circle of activity, it had only a temporary existence, and became almost extinct in the present era.

The history of pachyderms will form a contrasting episode compared to that of Cetacea, when it shall once be written out fully. Our hypothetical views on the subject, for fear that they should appear too premature, we abstain from giving now.

§ 7. As to the limits of the order of *Ruminantia*, every one is agreed ; but not so with regard to its systematic position. Considering its imperfect dental system, we see that it belongs to the great division of edentated mammals. That ruminants are inferior in rank to rodents, we derive first from their appertaining to the edentated division, which we have seen is inferior to the division of marsupials. Their dentition and herbaceous diet is a second very important feature which assigns to them a lower rank than to the rodents, which feed chiefly on bark and fruits, a food superior to grass and leaves.

§ 8. Now the position of the order *Rodentia* is clearly defined by what has just been said of the ruminants. Their complete system of dentition, and the similarity in the insertion of the incisors in herbivorous marsupials, are the reasons which have guided us in this arrangement.

§ 9. The place which we assign to the order of *Insectivora* is based upon a similar principle : the affinity of their dentition and mode of life with the insectivorous marsupials and edentata.

§ 10. *Pinnipedia* have always been placed below Carnivora, and Carnivora have always been divided into *digitigrada* and *plantigrada*. We find both plantigrada and digitigrada synthetically indicated in Pinnipedia; not in the structure of the locomotive members, but in the profile of the face.

§ 11. In the eccentric groups of *Bradipodidæ*, *Sciuridæ*, *Cheiroptera* and *Quadrumana*, we observe the remarkable fact that they assume a general external resemblance to each other, that they become monkey-like in features and habits. They live above the ground, in trees and in the air; they are chiefly nocturnal, and their diet has a general tendency to becoming frugivorous. That Cheiroptera proceed from the insectivorous stem, the Quadrumana from the carnivorous stem, the Bradipodidæ from the tardigrade stem, a thorough comparison of these types will convince every one.

We give now the following Mammalian System:

I. QUADRUMANA.
- Simiadæ.
- Cebidæ.
- Lemuridæ.
- Galeopithecidæ.
- Chiromyidæ.

II. CARNIVORA.
- *a.* UNGUICULATA.
  - 1. Digitigrada.
    - Felidæ.
    - Hyænidæ.
    - Canidæ.
    - Viverridæ.
    - Mustellidæ.
  - 2. Plantigrada.
    - Cercoleptidæ.
    - Procyonidæ.
    - Ursidæ.
- *b.* PINNIPEDIA.
  - Phocidæ.

III. CHEIROPTERA.
- *a.* FRUGIVORA.
  - Pteropodidæ.
- *b.* CARNIVORA.
  - Vespertilionidæ.
  - Vampyridæ.

IV. INSECTIVORA.

ERINACEIDÆ.
SORICIDÆ.
TALPIDÆ.

V. HERBIVORA.

a. RODENTIA.

SCIURIDÆ.
CASTORIDÆ.
MURIDÆ.
Myoxina.
Dipodina.
Ctenodactylina.
Murina.
Spalacina.
Arvicolina.
Bathyergina.
Saccomyina.
HYSTRICIDÆ.
Hystricina.
Dasyproctina.
Echymyina.
Octodontina.
Chinchillina.
Caviina.
LEPORIDÆ.

b. RUMINANTIA.

CAMELEOPARDALIDÆ.
CAMELIDÆ.
ANTELOPIDÆ.
CERVIIDÆ.
MOSCHIDÆ.
BOVIDÆ.

c. PACHYDERMATA.

EQUIDÆ.
SUIDÆ.
HYRACIDÆ.
RHINOCEROTIDÆ.
HIPPOPOTAMIDÆ.
TRICHECHIDÆ.
ELEPHANTIDÆ.
MASTODONTIDÆ.
RYTINIDÆ.
HALICHORIDÆ.
MANATIDÆ.
DINOTHERIDÆ.
ANOPLOTHERIDÆ.
PALÆOTHERIDÆ.

VI. CETACEA.

HETERODONTIDÆ.
DELPHINIDÆ.
PHYSETERIDÆ.
BALÆNIDÆ.

VII. MARSUPIALIA.

a. CARNIVORA.

THYLACINIDÆ.
DIDELPHIDÆ.
DASYURIDÆ.

b. INSECTIVORA.

PERAMELIDÆ.

c. HERBIVORA.

PHALANGISTIDÆ.
PHASCOLOMYIDÆ.
MACROPODIDÆ (*Halmaturidæ*).

VIII. EDENTATA.

a. TARDIGRADA.

BRADIPODIDÆ.
MEGATHERIDÆ.

b. EDENTATA PROPER.

DASYPODIDÆ.
ORYCTEROPODIDÆ.
MYRMECOPHAGIDÆ.
MANIDÆ.

c. MONOTREMATA.

ECHIDNIDÆ.
ORNITHORHYNCHIDÆ.

IV.

§ 1. The data relating to the earliest appearance of the class of Mammalia lead us as far back in the earth's history as the period of the oolite. There we find it displaying but a small number of forms under the shape of marsupials, more intimately allied, however, to our opossum tham to any of the Australian types. These first representatives of the class inhabited that geographical portion of the globe now called the British Islands.

The conclusions to which CUVIER had arrived, viz. that the epoch of the appearance of mammals was the tertiary in the series; his beautiful researches, his remarkable discourses on the revolutions of the globe, were present to the mind of every one. Now came that fossil jaw of an opossum-like animal, which seemed to contradict these philosophical deductions. The mammalian nature of the jaw was denied by some, exaggerated by others: its geological position in the oolite was considered as accidental; but all attempts at rejecting these remains from the class of mammalia have proved unsuccessful; time and repeated investigations have concurred in showing that they were true mammals, and that they truly belonged

to the oolitic period. And instead of contradicting the formerly ascertained results, these facts now complete the palæo-history of the class, and illustrate most beautifully the gradual introduction of the different groups of the animal kingdom upon the surface of our globe. For it remains true that the class of mammalia acquired a full development during the tertiary epoch only; the tertiary types were preceded in the secondary epoch by these marsupials, and in some sort foreshadowed, predicted by them. The marsupials being zoologically inferior, they are geologically the first created. Their abnormal forms, the disproportions of some of their limbs, illustrate the first evolution of the mammalian activity. Their bringing forth their young in an imperfect state of development, and the existence of an external pouch to protect that progeny, assign to them an inferior rank. The fact that there are among them carnivorous, insectivorous, and herbivorous types, indicates clearly that they combine these groups of which they are the prototype in the Creator's thought, and their precursors in time.

As the development of the class went on, and the foreshadowed groups appeared as distinct and independent manifestations of the mammalian organization, the marsupialian group was preserved within the limits of its original conception up to our epoch, in which it stands as an odd group which reminds us of a past order of things. In the actual fauna, Marsupialia are an isolated type which has deceived and misled all the systematic writers; still combining characters of several other types, if it is not understood that they are prototypic, and the lowest, they will give rise to contests as to their position in the system.

No facts illustrate better the immateriality of the relations which exist between the various groups of this class: they may foreshadow, they may prophetise, but they will continue to exist. There are no material transformations, no material permutations, from one group to another; for if such was the case, those first created groups, combining those of a later appearance, would not be found possessing the same material attributes, the same circle of vital activity as before. On the other hand, when the foreshadowed groups appear, they lose their zoological importance, and accordingly are confined to a geographical province physically lower, to remind us of their low position in the system.

§ 2. But if Edentata are zoologically the lowest of the class, they should have been created the first in time, or at least be contempo-

raneous with Marsupialia. As far as our present knowledge respecting the fossil remains of mammals goes, Edentata are not known prior to the miocene strata of the tertiary epoch; but in those very strata, their remains are so numerous, and exhibit such a diversity of generic forms, that we must conclude from these facts that Edentata have acquired, if not the maximum of their development, at least a large portion of it, during the first period of their creation.

This great development of Edentata, at the presumed dawn of their existence, is in contradiction with the general law which has presided over the development of all other groups of the animal kingdom: each group, each natural order or family, the history of which has been investigated in past times, has manifestly shown a development parallel to that of the individual life: 1st, an early period—corresponding to that of youth—during which the group has but a small number of representatives; 2d, a period of full development—corresponding to that of the adult—during which the group exhibits the greatest diversity which was in its power to assume; 3d, finally there is a period of decline—corresponding to old age and fall—during which period the individuals are less numerous. In the class of Mammalia there are comparatively few groups which have thus reached the third period of their history, and passed away from the surface of our earth. The majority have just attained their period of fullest development at the beginning of the human era, and are actually in existence upon the external surrounding crust of our planet.

According to these facts, and satisfied that the systematic position which we have assigned to Edentata is natural, and in accordance with the general plan of the creation, we predict that remains of Edentata will be found in the strata below the miocene; that they will be found in secondary beds at least as low as the Oolite, if not farther down. If they prove to be of a decidedly lower zoological grade than Marsupialia, they must have been introduced on earth before the latter; and if parallel with them, they must have been contemporaneous. In the actual era, the order of Edentata is in its period of decline: its representatives now living are much less numerous than the extinct ones already known.

§ 3. The Pachydermata constitute another group, whose history chiefly belongs to past times. They are known to have existed as early as the eocene period; the miocene is the period of their greatest dvelopment; they diminish in number in the pliocene, and

finally the living representatives are still less numerous. So that pachydermata are in the period of their decline, as well as edentata.

Now as far as is known, these two groups, Pachydermata and Edentata, are the only ones in the class of Mammalia whose circle of activity has been exhausted in geological ages.

The two series which we have established among pachyderms will have to be carefully studied geologically.

The oldest remains known of Sirenidia have been discovered in the lowest beds of the miocene period.

The oldest remains of ruminants known, belong to the middle strata of the miocene period.

Cetaceans are contemporaneous with the ruminants; it being always understood that we speak of the actual state of our knowledge.

Rodentia, which we consider the highest amongst Herbivora, are foreshadowed by Marsupialia, the second synthetical type. Rodentia make their first appearance at the beginning of the eocene period, the first of the tertiary epoch.

And so do the Carnivora proper and Pinnipedia, parallel in their genetical development; although, zoologically speaking, Pinnipedia are lower, and synthetise the two groups of carnivorous digitigrades and plantigrades.

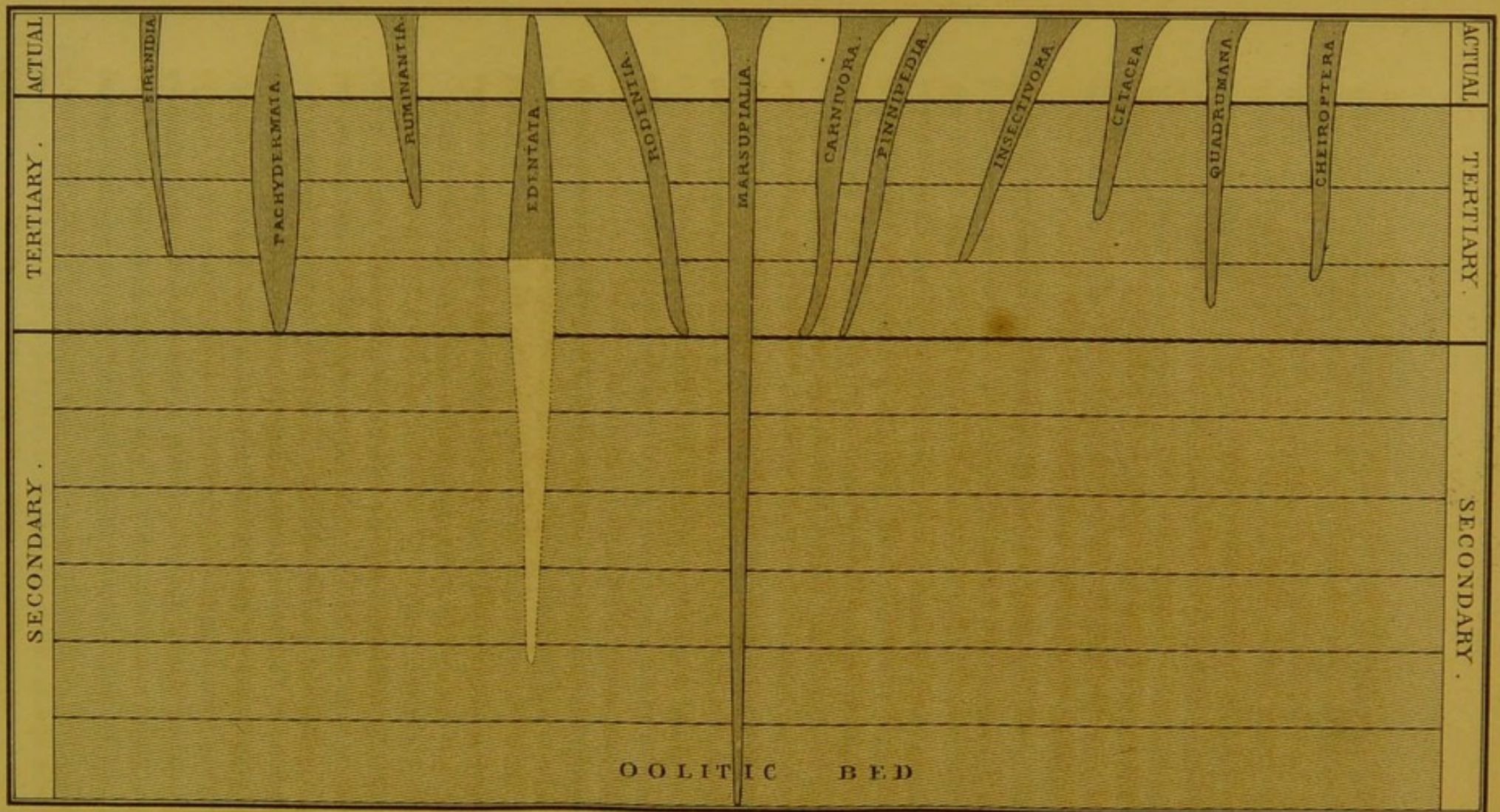
Insectivora, which are shadowed by both Edentata and Marsupialia, are not known in the eocene : their remains, hitherto found, belong to the miocene and strata above.

Quadrumana and Cheiroptera have left some of their remains in the middle strata of the eocene period.

The annexed diagram is intended to sketch out the history of the class of Mammalia, prior to the epoch of mankind.

§ 4. If we look now at the geographical distribution of Mammalia, which is regulated by laws, we may point out some facts of a very striking interest, and which corroborate the foundation of our classification.

The globe and the animal kingdom were created for one another; the globe, however, was made for the kingdom, matter being subordinate to life. During each of the geological ages, and even during each period or era, the physical features of the globe have assumed a peculiar character. The animal creation has likewise assumed a peculiar zoological character, always in a direct relation with the



CHRONOLOGICAL CHART OF THE CLASS OF MAMMALIA.

physical characters of the time and the special physical wants of the globe.

There are two points of view to be taken into consideration when investigating the introduction of life upon the surface of our globe, but these we cannot discuss at length here : we must limit ourselves merely to the signalizing of them.

1. Life, from its first manifestation upon the globe, may have undergone a gradual, slow, and continuous development ; in which case a single and unique creation, passing through divers metamorphoses to suit the wants of the globe, renewing itself without the necessity of a special creation at the beginning of each period, would seem the real doctrine.

2. Life, after its first introduction on earth, might have ceased at the end of each period, and, at the beginning of each one, a new creation called forth, purposely made to suit the physical wants of the new era. Thus numerous creations would have succeeded each other without any material connection, or any genetic relationship, but physically independent of each other.

Both of these views have their defenders and opponents. The choice of one or the other is of no consequence in regard to the fact which we are now tracing, as soon as we can admit that *at each period the animal kingdom was in a direct relation with the physical wants of the globe.*

The physical wants of our planet went on increasing with Time, both in number and importance ; and the same may be said of animal life. The relations of these two worlds are so intimate, that the zoological subordination of the groups will give us the relative physical superiority of the continents above one another ; and, *vice versa*, the relative physical superiority of the continents will point to the zoological gradations of the groups composing the class of mammalia.

Now let us look at the facts. The lowest Mammalia, the Monotremata, belong exclusively to Australia. Australia is physically the lowest continent. Marsupialia are also limited to the same continent.

The next in grade after Monotremata are the Edentata proper, which belong chiefly to South America ; the Manidæ and Orycteropodidæ alone being African. South America and Africa rank above Australia ; and although Marsupialia are placed by us above Edentata generally, the consequence of their occurring in Australia does not contradict the assumption that Australia is physically lower than

Africa and South America. The fact that the lowest among Edentata are Australian, and the highest among Marsupialia (the Didelphidæ) are South American, is very conclusive.

The occurrence of the opossum in the southern part of the United States clearly indicates that this continent is physically inferior to Europe and Asia.

When comparing the relative superiority of the continents with each other, the comparison, in order to remain true, must be made independently of the influences of man. They must be taken at the dawn of their history, when in formation, during the epochs which have preceded the cradle of mankind. If America occupies a relatively low physical rank, that nation by which it has been taken possession of, by which it has been subdued and conquered, has changed its destinies by applying to its elevation the power of its intellectual aptitudes.

Although some few fossil remains of Marsupialia and Edentata occur out of the actual geographical provinces of these groups, the greatest number are found within the limits of the said provinces; showing that the order which now prevails at the surface of our globe, takes its roots in former ages; that the same general laws which now prevail, have presided over the past.

Amongst the normal groups of the class we have Cetaceans, the lowest, all aquatic; as are likewise Sirenidia, Trichechidæ, and Pinnipedia. The pachyderms are tropical: their actual distribution on earth is to be referred to a past order of things, in order to be understood. The Ruminants, Rodents, Insectivora and Carnivora are distributed all over the globe in given proportions.

A general glance at the mammalian fauna of North America strikes us by the preponderance in the number of species of the order Rodentia. The true grass-feeders, the Ruminantia and Pachydermata are in minority; although the new world has been opposed to the old, and called the *continent of vegetation*, by contrast with that of *animalization*. The greatest Carnivora are absent from America: Carnivora are the most numerous where ruminants are most numerous, the former feeding chiefly upon the latter.

Each group has a part to perform in the economy of nature. Carnivora, the most powerful in the animal creation, check the ruminants, the most bulky and most clumsy of the terrestrial forms of the class, and partly the rodents; the rodents, in their turn, check the arborescent vegetation, whilst ruminants check chiefly the grass.

Ruminants are constructed to walk on the surface of the ground; whilst the organization of rodents is adapted either for ascending trees, or for burrowing in the ground. Ruminants are timid, constantly in fear of becoming the prey of others, and have for their only retreat the depths of the forests, or the unbounded plains and deserts.

The Insectivora feed upon Articulata, and are intended chiefly to check the never-resting class of Insects : they are adapted to divers situations ; for the aerial element, the surface of the soil, and under it, as their peculiar instinct will lead them to feed either on flying, creeping, or burrowing articulates. The Insectivora increase in number from the north to the equator, as the class of insects does.

Amongst the eccentrical types, the majority of the species inhabit the warm zone ; a very significant fact. Cheiroptera exist in both hemispheres, increasing in number from the arctic regions to the tropics. Quadrumana are chiefly tropical ; and so are Bradipodidæ. Flying squirrels belong to the temperate and tropical zones.

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9. On the Preservation of Animal Substances. By Dr. H. Goadby.

Dr. Goadby's preserving fluids are made according to the following formulæ :

A 2.

Rock salt	4 ounces.
Alum.....	2 ounces.
Corrosive sublimate,	4 grains.
Water	2 quarts (*imperial* of 40 ounces).

B.

Rock salt	8 ounces.
Corrosive sublimate,	2 grains.
Water	1 quart, imperial.

The A 2 fluid only differs from the A 1, by the employment of *two* quarts of water to the same ingredients, instead of *one quart.*

B fluid, made according to the above recipe, is adapted to the preservation of land and lacustrine animals : marine animals require about two ounces more salt to one quart of water. The sp. gravity should be 1,148.

III. PHYSIOLOGY.

10. Influence of the Poison of the Northern Rattlesnake *(Crotalus durissus)* on Plants. By J. H. Salisbury, M. D., of Albany.

On the eighteenth of June, 1851, a large female rattlesnake, which had been caged in the New-York State Cabinet of Natural History for about a year without food, died. On dissection, its stomach and intestinal canal were found entirely empty, as much so as if they had been scoured out with soap-suds. The sack in which the poison is emptied was laid open, and the virulent matter (of which there was but little) carefully removed and placed in a porcelain capsule. About fifteen minutes after its removal, four young shoots of the lilac *(Syringa vulgaris)*, a small horse-chestnut of one year's growth *(Æsculus hippocastanum)*, a corn plant *(Zea maiz)*, a sunflower plant *(Helianthus annuus)*, and a wild cucumber vine, were severally vaccinated with it. The vaccination was performed by dipping the point of a penknife into the poisonous matter, and then inserting it into the plant, just beneath the inner bark. No visible effect, in either case, of the influence of the poison was perceptible till about sixty hours after it had been inserted. Soon after this the leaves above the wound, in each case, began to wilt. The bark in the vicinity of the incision exhibited scarcely a perceptible change; in fact it would have been difficult to have found the points, if they had not been marked, where the poison was inserted. Ninety-six hours after the operation, nearly all of the leaf-blades, in each of the plants above the wounded part, were wilted and quite dead. On the fifth day, the petioles and the bark above the incisions began to lose their freshness; and on the sixth, they were considerably withered. On the seventh day they appeared about as they did on the sixth. On the tenth, they began to show slight signs of recovery. On the fifteenth, new but sickly appearing leaves began to show themselves on the lilacs, and the other plants began to present slight signs of recovery in the same way. Neither of the plants were entirely destroyed.

It was interesting to mark the progressive influence of the poison. The first indication of the derangement of the healthy functions of