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Author: Gasso Miracle, M.E.

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PART TWO

“Système de la nature”

CHAPTER FOUR

Patterns, laws and the type concept¹

Temminck's law on animal distribution patterns

Which animals could be found where, and why, was a particularly problematic issue in systematics. Animals were being arranged mainly according to their anatomical features (external and internal), but their habits and distribution were thrown in as additional information that helped clarify the degree of relatedness between them. Naturally, *relatedness* was at the time interpreted not as genetic kinship, but as a degree of morphological similarity that placed particular groups close to each other in the great catalogue of life. This was a deceptively simple concept. As more and more animals were being discovered, their geographical distributions often seemed to contradict the arrangements one could make from their anatomy. How could there be marsupials in North America and Australia but nowhere in between? How did a sluggish and lethargic animal like the sloth ever manage to travel after the biblical deluge from the mountains of Ararat all the way to South America? It was perplexing. Any interpretation of the distribution of animals invariably meant getting engaged in prickly discussions about the origin and the fixity of species, and the meaning of variations. The answer to these questions posed several scientific and philosophical problems. The main issues were the origin of species, including humankind, the species concept, the limits of species variation, the veracity of the biblical account, and whether nature is governed by universal laws or by direct intervention by God. These were not discussions for the faint of heart.

Between the late 1820s and the late 1830s Temminck published a small number of works on biogeography. He was dealing with the fauna of South-east Asia and Japan,

¹ This chapter is partly based on a previously published article, M. Eulàlia Gassó Miracle, "The Significance of Temminck's Work on Biogeography: Early Nineteenth Century Natural History in Leiden, the Netherlands," *Journal of the History of Biology* 41, no. 4 (2008). Changes have been made to include new insights and references, and to avoid duplications in this book.

mostly because of the specimens available to him in the Leiden museum collected by Reinwardt, the Natuurkundige Commissie, Philipp F. von Siebold, Heinrich Bürger, and a few others. These works are remarkable for two reasons. Firstly, in them Temminck accurately described the species composition of poorly explored regions, like the Sunda Islands and Japan. Secondly, he formulated a new law on the geographical distributions of animals around the globe, based on the parallels he observed between the fauna from Europe, Asia and Japan. The underlying ideas that led Temminck to this law were the type concept, which he understood as the ideal morphological plan behind animal form, the unchanging character of the species and a strong belief in nature's divine design.

Temminck repeatedly stressed the importance of considering animal distribution patterns for understanding nature. He used the geographical distribution patterns of species to complement morphology in his classification of birds. He emphasized that studying animal distributions and comparing the fauna of similar latitudes was a subject "rich in facts and consequences" for science.² Charles Darwin noted: "Geographical distribution has often been used, though perhaps not quite logically, in classification, more especially in very large groups of allied forms. Temminck insists on the utility or even necessity of this practice in certain groups of birds; and it has been followed by several entomologists and botanists."³

While studying the Asian collections in Leiden, Temminck began to ponder the differences and similarities in bird and mammal fauna of the Sunda Islands and Japan. In 1828 he published an article in Dutch entitled *Blik op de dierlijke bewoners van de Sunda-eilanden en van de overige Nederlands bezittingen in Indië* (An overview of the animal inhabitants of the Sunda Islands and other Dutch possessions in the Indies). In this article Temminck briefly listed which species could be found where and noted the differences in species composition between islands. Two additional essays on biogeography appeared in Philipp Franz von Siebold's *Fauna Japonica*. Two sections from this magnificent publication are of special interest here: the general introduction (*Coup-d'oeil sur la faune des Iles de la Sonde et de l'Empire du Japon*) and the introduction to the volume on mammals (*Aperçu général et spécifique sur les mammifères qui habitent le Japon et les îles qui en dépendent*). The first was published in 1836 as a general introductory essay to the *Fauna Japonica*. Temminck formulated here, for the first time, a general law concerning the geographical distribution of animals on the globe. Two years later,

² Coenraad Jacob Temminck, "Over de kennis en de verbreiding der Zoogdieren van Japan," *Tijdschrift voor Natuurlijke Geschiedenis en Physiologie* 5, no. 4 (1838): 293; "Aperçu général et spécifique sur les mammifères qui habitent le Japon et les îles qui en dépendent," in *Fauna Japonica sive Descriptio animalium*, ed. Philipp Franz von Siebold, vol. 5 (Leiden: A. Arnz et socios, 1842), 8.

³ Charles Darwin, *On the Origin of Species by Means of Natural Selection* (London: John Murray, 1859), 419.

Temminck published a translation of this essay under the title *Over de kennis en de verbreiding der zoogdieren van Japan* (About the knowledge and the distribution of mammals of Japan).⁴

The *Coup-d'oeil général sur les possessions néerlandaises dans l'Inde Archipélagique* (1846–1849) is of particular interest in this context. In general, Temminck's *Coup-d'oeil* was received as a wide-ranging and consistent work, which relied only on facts; a trustworthy source of information for those wanting to learn more about the Dutch East Indies.⁵ It is because of his care in selecting the available information and his attention to detail that many other naturalists would consult it for data to complement their own work on biogeography, like William Swainson, Andrew Murray, Charles Darwin or Jan Baptist Jozef van Doren.⁶

Because of his attention to the geographical distribution of birds and mammals, Temminck began to spot certain generalities. After comparing the fauna of Central Europe, North America and Asia with the newly described species from Japan, he formulated a general law on “animal organization,” as he put it. According to his principle there is a correlation between the fauna from different regions of the globe, namely, that animals living in the same latitude display the same organization, external form and behavior:

The zoological products of Japan [...] offer us new evidence of the geographical distribution of living beings: they help us establish this law of animal organization, [...] according to which there is a relation in organization, external form and behavior between almost all animals that inhabit the same latitude, however far from each other the regions may be where they live and freely disperse. The extension of the seas between regions has no influence on this, and

⁴ Coenraad Jacob Temminck, “Blik op de dierlijke bewoners van de Sunda-eilanden en van de overige Nederlandsche bezittingen in Indië,” *Bijdragen tot de Natuurkundige Wetenschappen* 3 (1828); Temminck, “Zoogdieren van Japan”; Temminck, “Aperçu général, Fauna Japonica,” vol. 5. In my previous article “The Significance of Temminck’s Work on Biogeography,” I erroneously gave 1842 as the year of publication of the *Coup-d'oeil sur la faune des Iles de la Sonde et de l'Empire du Japon*.

⁵ For example, Ulrich Gerard Lauts, professor of Dutch language and literature at the Museum for Science and Arts in Brussels, was very positive in his reviews: “Nieuw uitgekomen boeken: Coup-d'oeil général sur les possessions néerlandaises dans l'Inde Archipélagique par C. J. Temminck, 1846,” *Algemeene Konst- en Letterbode* 1, no. 12 (1847); and “Nieuw uitgekomen boeken: Coup-d'oeil général sur les possessions néerlandaises dans l'Inde Archipélagique par C. J. Temminck, 1847,” *Algemeene Konst- en Letterbode* 1, no. 9 (1849).

⁶ Jan Baptist Jozef van Doren, *Mémoire sur les Quadrumanes et les Chéiroptères de l'Archipel Indien* (Amsterdam: J. D. Sijbrandi, 1868); Andrew Murray, *The Geographical Distribution of Mammals* (London: Day and Son, limited, 1866); Swainson, *Treatise on the Geography*. For Darwin's use of the *Coup-d'oeil*, see Jane R. Camerini, “Evolution, Biogeography, and Maps: An Early History of Wallace's Line,” *Isis* 84, no. 4 (1993).

neither has the enormous space of uninterrupted land that stretches between them.⁷

This law is a generalization of the parallels that Temminck had observed between the mammals from Japan with those inhabiting Europe, Asia and North America. The general principle was drawn from observing the fauna across the Northern hemisphere, but it was assumed to be valid for the whole globe. The law was, however, less applicable to the Southern hemisphere, where there is a higher degree of diversification of forms in the tropical and subtropical regions. Unfortunately, Temminck did not attempt to explain this difference:

This law is applicable in some respects to both hemispheres, but more strictly so to the Northern hemisphere, where the species are exactly the same, while in the Southern hemisphere the groups and the species are distributed following a more diverse model, even though they very often present analogies with the animals that live in parallel latitudes.⁸

In these few lines we find encapsulated the theoretical foundations of Temminck's thinking, the underlying ideas that guided his zoological works and by extension, his writings, his goals and his museum politics.

The type and species concepts

After studying the mammals of Japan, Temminck concluded that none of the new species on that island were substantially different from those already known from central Europe or Asia. There are no mammals in Japan with a fundamentally new morphology, like the marsupials from Australia. There are no monkeys in Japan either, with the exception of a single species, which is in every way comparable to the only species of monkey in Europe, the Gibraltar monkey, or the Barbary Ape. Temminck noted that both monkeys lived in regions with similar climates. In fact, in Europe, Japan, central Asia or North America there are no monkeys or apes like those of tropical regions.⁹ Hence his universal principle, according to which animals from a particular region are alike in their *general organization* to animals from other areas on the same latitude:

⁷ Temminck, "Aperçu général, Fauna Japonica," vol. 5, 7. This passage is a literal translation of the Dutch formulation of the law of 1838 in "Zoogdieren van Japan." Apparently, Temminck found no reason to expand or alter the original text.

⁸ Temminck, "Aperçu général, Fauna Japonica," vol. 5, 7.

⁹ Temminck, "Aperçu général, Fauna Japonica," vol. 5, 4.

Among the Japanese mammals not a single species has been found that differs from the known basic forms (*types*) in any distinctive manner, such as those found in Australia, with the exception of a few mammals that differ slightly from the known genera; all other mammals can be placed in the European and Asiatic systematic categories.¹⁰

In other words, the same basic forms or *types* inhabit similar latitudes. For Temminck, the “types d’organisation” are molds for building living beings; they represent the morphological plan upon which a group of similar animals is built and each type manifests itself in every region of the same latitude.¹¹

Every type is definite, and clearly separated from other types. However, Temminck hastened to clarify that, although animals from the same types lived in Asia and North America, the species were different from each other due to “local deviations” from the original type. Because of these deviations from the original form, species were difficult to define: there was nowhere a sharp break between them that allows us to clearly separate one species from the next.¹² In other words: Temminck identified the type as the basic mold for a genus, and species were varieties of that genus, the physical expression of the type in a particular region of the globe.¹³ Species should then be defined by the principal characteristics of the genus they belonged to, that is, of the ideal type. Temminck wrote that if all variations of a type were to be described as separate species, this would only obstruct the progress of science, and would make naturalists use for their classifications characters that were insignificant, only recognizable “with the scalpel in the hand or with a magnifying glass before the eye,” while in fact one could, “at first glance, recognize all the main characters that belong to the type of the true species.”¹⁴ For example, a bear is, he explained, in its general sense a basic form of organization, a type, while the American bear is the expression of the type in that particular region, North America.¹⁵ Temminck’s type corresponds to the taxonomic category of the genus. The type embodies the common morphological features shared by a group of species, each living in a different region of the globe, in the same way as the genus manifests itself in similar species.

The difference between the type and the species in Temminck’s thinking reflects his belief in the principle of continuity. What he observed in the collections was actually a continuum of forms—the oft-quoted principle *natura non facit saltus*. When he

¹⁰ Temminck, “Zoogdieren van Japan,” 287.

¹¹ Temminck, “Aperçu général, Fauna Japonica,” vol. 5, 7.

¹² Temminck, “Zoogdieren van Japan,” 8.

¹³ Temminck, “Aperçu général, Fauna Japonica,” vol. 5, 8.

¹⁴ Temminck, “Zoogdieren van Japan,” 292-93.

¹⁵ Temminck, “Zoogdieren van Japan,” 283-84.

described a new species of shrew mole from Japan, Temminck was confident that it “filled a gap in the animal series,” proving that as naturalists advanced in their research, they would eventually describe all the “links of this uninterrupted chain, which closely links together the different groups of animals,” both ancient and living.¹⁶ A clean break between species was nowhere to be seen:

The sight of a multitude of individuals from the same species, native to different regions, clearly indicates how difficult it is sometimes to determine precisely the limits between analogous species, and to affirm that there is a specific separation or a well-traced demarcation for all the species we recognize as such. In sum, the existence of *Genera*, in its conventional meaning, seems a paradox to me: I am even far from accepting the existence of *species* as axiom.¹⁷

It explains Temminck’s emphasis on the need for choosing the right characters to define species and genera, as well as his reluctance to split genera, as we will see in the next chapter.



FIGURE 4.1. Illustration of the Japanese macaque *Inuus speciosus* in Von Siebold’s *Fauna Japonica*, vol. 5 (1842).

¹⁶ Coenraad Jacob Temminck, “Description d’un nouveau genre de Mammifères (Urotrichus),” *Magasin de zoologie, d’anatomie comparée et de palaeontologie* 4 (1842): 1.

¹⁷ Temminck, “Introduction à cette troisième partie,” in *Manuel d’ornithologie*, 2 ed., vol. 3, xix.

Temminck's concept of the species is rather unclear. Species could, and did, differ from one another depending on their distribution. A species, Temminck wrote, although it is modeled after a certain *type*, is under the influence of the climate of the particular region where it lives. He gave several examples of species belonging to the same type (and thus, classified as belonging to the same genus) that were slightly different from each other because they inhabited regions with a different climate. For instance, Temminck described two new species of bats from Japan that are both covered by a thick layer of wool, while similar species of the same genus that live in tropical forests are almost hairless.¹⁸ Similarly, a snow leopard living in the Altai Mountains has a dense, thick coat, but a Sumatran leopard has short, shiny fur. The leopard, according to Temminck, is provided by nature with very thick and long fur when living near the pole.¹⁹ Nature is directly responsible for shaping the type into different species according to the climatic conditions of the places in which these animals live.

Just as climate has an impact on a type to produce different species, certain features within species can also be influenced by local conditions. The deviation from the basic model is, in this case, even smaller. Species of the same type share a basic morphology, "without denying," Temminck wrote, "that species can undergo certain alterations and appear as slightly different varieties; this does not mean that these varieties are divergent enough to isolate them from the types and to classify them as truly different species."²⁰ These altered forms, or varieties, differ but little from the original species by, say, different size or coloration. Temminck did not clarify to what extent species might differ from the type.

It is important to note that even though different species exist as a consequence of the environment, this is not a transformist argument, in the sense that species adapt to the environment and change into new, different species. The scope of variation is limited, and there is no word about the transformation of species in a progressive, directed sense, in any of Temminck's publications. The same is true for varieties within species. The different features of species and varieties are "provided by nature" from the beginning. Furry leopards belong to cold areas, and Temminck never suggested that if a bald Sumatran leopard decided to migrate to Mongolia, its descendants would grow thick fur in their new, cold environment.

¹⁸ Temminck, "Zoogdieren van Japan," 282.

¹⁹ Temminck, "Zoogdieren van Japan," 283.

²⁰ Temminck, "Aperçu général, Fauna Japonica," vol. 5, 8.

Temminck's typological thinking, with types seen as molds or models, was a common concept during the eighteenth and early nineteenth centuries.²¹ Georges-Louis Leclerc de Buffon attempted in his encyclopedic work *Histoire naturelle, générale et particulière* to present a theory of the earth and the natural history of minerals, humans, quadrupeds and birds. Buffon's ideas evolved over time, sometimes even appearing contradictory in different volumes of the *Histoire naturelle*, but nonetheless his observations had a notable influence on how naturalists after him looked at the natural world.²² Buffon described a "prototype" or archetype "upon which each individual is modeled, but which seems, in its actual expression, to be altered or improved by circumstances; therefore, with regard to certain characteristics, there appears to be an astonishing variation in the succession of individuals, and, at the same time, an admirable uniformity in the entire species."²³ All horses, for example, are always shaped after the "first horse," which is "the exterior model and the interior mold."²⁴ This "interior mold" is more than an ideal plan, as it acts both as an arranging force and as a model for all animal forms. The characters of the "prototype" were perpetuated generation after generation, and they changed as the species multiplied.

The species was, for Buffon, an historical continuity that did change over time.²⁵ Temminck's type, in contrast, is fixed and eternal, as we will see below. He rejected Buffon's view that all species belonging to a certain group, say, an order, were descended from a single original source. In doing so he also implicitly rejected Buffon's idea of the interior mold as an arranging force:

What a strange error it is to indicate the Bizet or the Wild Pigeon as the common ancestor of all different species of Pigeons on the surface of the earth; what are the reasons that have led M. Buffon to establish a law that nature denies in every individual? I will make these reasons known and then it will be easy to prove that M. Buffon's supposition lacks any credibility. The lack of observations made of nature is the principal source of an error that results from a too great confidence in his creative genius; this confidence, fatal for science, perpetuates

²¹ For an in-depth discussion of the morphological type concept and its evolution in the nineteenth century, see Joeri Witteveen, "Suppressing Synonymy with a Homonym: The Emergence of the Nomenclatural Type Concept in Nineteenth Century Natural History," *Journal of the History of Biology* 49, no. 1 (2016).

²² For more information on Buffon's writings and how they evolved over time, see for example Paul Lawrence Farber, "Buffon and the Concept of Species," *Journal of the History of Biology*, vol. 5, no. 2 (1972); Jacques Roger, *Buffon: A Life in Natural History*, trans. Sarah Lucille Bonnefoi (Ithaca and London: Cornell University Press, 1997).

²³ Georges Louis Leclerc Buffon, "Quadrupèdes," in *Histoire Naturelle, générale et particulière, avec la description du Cabinet du Roi*, vol. 1 (Paris: P. Didot l'ainé et Firmin Didot, 1799), 61-62.

²⁴ Buffon, "Quadrupèdes," 62.

²⁵ Farber, "Buffon and the Concept of Species," 263-66; Roger, *Buffon: A Life in Natural History*, 399-400, 12.

the aberrations of a great man, whose merits are justly respected and whose talents, honored.²⁶

The differences between some groups of pigeons, Temminck continued, are so clear and definite that they should never have “escaped such a great genius.”²⁷ The whole group of pigeons could not possibly have originated from just one original species. To him, Buffon’s assumption that climate alters form in such a way as to create new species was unfounded and entirely wrong. While the nuances in color may be due to the environment, climate has not “the magical power” to affect coloration and size in any significant way.²⁸ Buffon, he claimed, had failed to observe that not only the external morphology of these species of pigeons is distinct; their behavior and anatomy are different as well. Temminck did not accept that animals were subject to any significant change under the influence of “circumstances”. Therefore, he could not agree either with the idea of an interior mold behind those changes. While Buffon thought of the prototype as the source for the whole group of pigeons—or horses, for that matter—Temminck argued that many types were necessary to explain the diversity of the entire order of pigeons, that diversity is so great that it could not possibly have come into being only by the influence of the climate on a single primordial form.

Temminck’s type fits in the category of Paul Farber’s “morphological type-concept,” which he defined as a “basic plan or type that could be discerned at various taxonomic levels.”²⁹ According to Farber, the type concept that dominated pre-Darwinian natural history was that of George Cuvier. Cuvier believed in a natural, true and permanent plan of organization behind every form. There was a type for every level of organization, from his four *embranchements* to the species. Cuvier insisted on the unity of form at every level of organic function, and this unity applied to species but also to genera, families, and so on. Deviation from the types had to be limited because, according to the principles of comparative anatomy he established, any significant change in the animal body leaves it unable to function properly.³⁰ Therefore, animal

²⁶ Temminck, “Discours sur l’Ordre des Pigeons,” in *Histoire naturelle générale des pigeons et des gallinacés*, vol. 1, 16.

²⁷ Temminck, “Discours sur l’Ordre des Pigeons,” 17.

²⁸ Temminck, “Discours sur l’Ordre des Pigeons,” 23.

²⁹ Farber, “Type-concept in Zoology,” 100-01. The development of the morphological type through the eighteenth and nineteenth centuries has recently been explored by Witteveen, “Naming and Contingency.”

³⁰ For more information on Cuvier’s theories see for example Appel, *The Cuvier-Geoffroy Debate: French Biology in the Decades before Darwin*; William Coleman, *Georges Cuvier, Zoologist. A Study in the History of Evolution Theory* (Cambridge: Harvard University Press, 1964); Dorinda Outram, *Georges Cuvier: Vocation, Science, and Authority in Post-revolutionary France* (Manchester: Manchester University Press, 1984); Rudwick, *Georges Cuvier*.

morphology could not be as changeable as Buffon and Lamarck proposed: “There are thus characteristics in the animals which resist all influences, whether natural or human, and nothing indicates that the passage of time has, so far as they are concerned, more effect than the climate and domestication.”³¹ Temminck shared with Cuvier not only the notion of type as the basic form of organization, but he also saw variations of a species in exactly the same way as Cuvier did, that is, as limited to size and color. Cuvier wrote:

Thus the most superficial characteristics are the most variable. Color is closely related to sunlight; the thickness of the hair to heat; size to the abundance of nourishment. [...]. Thus, although the wolf and the fox live from the torrid zone right up to the glacial zone, they hardly give evidence, in this immense space, of another variety except for a little more or a less beauty in their fur.³²

The question of the relation between variation and climate had also caught the attention of the German zoologist Constantin W. L. Gloger. In 1833, he observed that birds tended to be darker near the equator, where the environment is more humid.³³ This link between climate and coloration in birds applied in fact to all warm-blooded animals, and it is now known as “Gloger’s rule”: humid climates are inhabited by darker varieties of a given species. Temminck did not mention this rule in any of his works on biogeography or when discussing variation. It is possible that he was unfamiliar with it, as Gloger’s publication of 1833 is not amongst the books Temminck owned, according to the auction catalogue of his library, even though other works by the same author are listed.³⁴

Étienne Geoffroy Saint-Hilaire also based his theories on the idea of a morphological type or, more explicitly, on the unity of type. Geoffroy Saint-Hilaire, in contrast to Cuvier, stressed form above function, that is, function is a consequence of form. Geoffroy Saint-Hilaire concluded that animal form could change without leaving the body so altered that it was unable to function properly anymore, and he proposed that species are not fixed in their morphology. Even more, he believed that more complex forms had progressed from simple ones. He maintained that vestigial organs, homologies, fossils and embryological studies indicated the common origin of actual forms, which were descended from one archetype. Cuvier vigorously opposed his

³¹ See Georges Cuvier, *Discours sur les révolutions de la surface du globe: et sur les changemens qu’elles ont produits dans le règne animal* (Paris: Chez G. Dufour et Edmond d’Ocagne, 1826), 62. Translated by Ian Johnston, 2009.

³² Cuvier, *Discours sur les révolutions*, 59-60. Translated by Ian Johnston, 2009.

³³ Constantin Wilhelm Lambert Gloger, *Das Abändern der Vögel durch Einfluss des Klima’s* (Breslau: August Schulz & Co., 1833).

³⁴ See the 1858 auction catalogue of Temminck’s library, *Catalogue de la bibliothèque délaissé par C. J. Temminck* (Leiden: E. J. Brill et C. van der Hoek).

views.³⁵ The affair ended in one of the most notorious debates in the history of biology, and one of the most heated. Although the views of both scientists were widely known in the world of natural history, we have found no direct reference to Geoffroy Saint-Hilaire's unity of plan in Temminck's writings, but because of his belief in the fixity of the species, as we will see below, he could never have agreed with one of its more polemical implications: transformism.

The parallels between Cuvier's theories and Temminck's ideas are very significant. Temminck admired Cuvier and considered him one of the greatest minds in natural history. He frequently visited Cuvier in Paris and they wrote each other regularly. He referred to Cuvier as "mon maître, et depuis lors mon ami".³⁶ He manifested his esteem for Georges Cuvier by dedicating to him the *Nouveau recueil de planches coloriées d'Oiseaux* as "an expression of our most respectful devotion."³⁷ Cuvier's writings strongly influenced Temminck and it seems that he applied the typological thinking of Cuvier to interpret the patterns of animal distribution he observed in the Dutch East Indies and Japan. It is possible that Temminck developed his law to fill the gap—biogeography—left by Cuvier in his writings, applying Cuvier's principles of comparative anatomy and his type concept to the subject of animal distribution.

Temminck's law versus Buffon's law

Buffon was as intrigued by the problem of geographical distribution patterns as almost all other naturalists. He addressed it in his *Histoire Naturelle*, starting with the proposition that animal organization was the result of external factors, that is, of the environment in which they originated. He concluded that each fauna belonged to a certain area of the world, and he expected that regions with similar environmental conditions would contain similar species.³⁸ But the newly discovered species from tropical countries contradicted Buffon's expectations. He observed that what naturalists had found in the Old and New World were different kinds of animals, even under the same climatic conditions. Buffon explained these unexpected findings by bringing into play geographical barriers. Mammals simply found those physical barriers

³⁵ See, for example, Appel, *The Cuvier-Geoffroy Debate*.

³⁶ Temminck, "Avant-propos," *Coup-d'oeil général*, vol. 1, ix.

³⁷ Temminck and Laugier de Chartrouse, "A monsieur le Baron G. Cuvier," *Nouveau recueil de planches coloriées*, vol. 1.

³⁸ Buffon, "Histoire Naturelle, générale et particulière, servant de suite à l'Histoire des Animaux quadrupèdes," in *Histoire Naturelle*, vol. 3, Supplément, 270. See also Mayr, *The Growth of Biological Thought*, 441.

insurmountable and therefore, different species of quadrupeds were isolated and unable to spread from one continent to the other. And with that, Buffon changed his mind:

All of the animals that, by their nature, are unable to support the climate of the north, even those that can support it but are unable to reproduce in it, are therefore confined on two or three sides by oceans that they cannot cross, and on another side by regions so cold as to be uninhabitable. Accordingly, there is no longer any reason to be astonished by the general fact, which first appeared very strange, and which no one before us even suspected, that no species of the torrid zone of one continent is found in the other.³⁹

He concluded that different species must inhabit different regions:

We do not presume to affirm categorically that, of all the animals that live in warm climates in one or the other continent, there is none that lives in both; to do so and be absolutely certain would require knowledge of the facts. We merely offer a judgment, because such is evident for all of the large animals, which are the only ones generally noticed and well described by travelers; because such is also fairly clear for the majority of the small animals, and of them there are only a few for which we cannot yet judge. If some exceptions are discovered (which is difficult for me to imagine), they could involve only a few cases, and would not destroy the general law that I have just established, and that appears to me to be the only compass that can guide us in our investigations of animals.⁴⁰

Alexander von Humboldt and Augustin Pyramus de Candolle arrived at the same conclusion by studying plants or by comparing the fauna or flora between other regions.⁴¹ Humboldt combined his own observations on vegetation with Buffon's passage and extended it to a principle that applied to the whole globe and to all animal groups, including birds, insects and reptiles.⁴² The principle is referred often to as "Buffon's law": different forms in different regions. It was, like Temminck's law, a generalization; it was mostly based on the comparison of mammals between the Old and the New World only. But nonetheless, by the 1820s Buffon's law was widely acknowledged by naturalists. The Scottish geologist Charles Lyell quickly adopted it: "the French naturalist caught sight at once of a general law in the geographical

³⁹ Buffon, *Histoire Naturelle*, vol. 9, 96. Translated by Gareth Nelson, "From Candolle to Croizat: Comments on the History of Biogeography," *Journal of the History of Biology* 11, no. 2 (1978): 275.

⁴⁰ Buffon, *Histoire Naturelle*, vol. 9, 118-19; translated by Nelson, "From Candolle to Croizat," 275-76.

⁴¹ For the history and implications of Buffon's law see Nelson, "From Candolle to Croizat." A general history of biogeography can be found in Janet Browne, *The Secular Ark: Studies in the History of Biogeography* (New Haven: Yale University Press, 1983).

⁴² Alexander von Humboldt, "Sur les lois que l'on observe dans la distribution des formes végétales," *Annales de Chimie et de Physique* 1, 2nd ser. (1816): 234.

distribution of beings, namely, the limitation of groups of distinct species to regions separated from the rest of the globe by certain barriers.”⁴³ Soon after, Charles Darwin and Alfred Russell Wallace were also concerned with the differences in species composition between different regions—concerns that led them to elaborate their own theories to explain this phenomenon.

Temminck’s law is exactly the opposite of Buffon’s law. Was Temminck ignorant of Buffon’s observations? Presumably not. Although no reference to Buffon can be found in Temminck’s publications on animal distribution, Temminck was a well-informed, well-connected naturalist. His library contained four different editions of Buffon’s *Histoire naturelle* and Temminck often referred to it in his works.⁴⁴ Nevertheless, the same principle was described in almost every work of natural history that dealt with the patterns of geographical distribution, works Temminck was familiar with. On top of it, Temminck corresponded with Humboldt, Cuvier, Illiger and other European naturalists, and visited them on several occasions.⁴⁵ It is hard to imagine that Temminck had never read Buffon’s law or works that referred to it, or talked about it with his colleagues. But there is no allusion to Buffon’s observations about the geographical distribution of animals or to his history of life on earth in Temminck’s discourse on animal distribution.

There are certain elements in Temminck’s thought that may have led him to formulate a law opposed to Buffon’s observations. In the first place, Buffon and other naturalists highlighted the differences between the Old and the New World, that is, between Europe and America. Their emphasis on variation is absent in Temminck’s theories. He based his law on the similarities between Europe, Asia, Japan and North America. Even when Temminck described the nature of species and its variations, he focused on the features common to related forms, more than on specific characters, while others centered their attention upon individual species instead of upon their general organization plan. In fact, all naturalists dealing with distribution patterns during the first half of the nineteenth century, like de Candolle and Humboldt, agreed with Temminck that species from different regions, in their most basic form, were analogous. De Candolle wrote: “The same distance from the equator, or the same degree of latitude, produces rather a resemblance in the forms—an agreement in the families and genera—than the same species, chiefly because, besides this geographical latitude,

⁴³ Charles Lyell, *Principles of Geology: Being an Attempt to Explain the Former Changes of the Earth’s Surface, by Reference to Causes now in Operation*, 1 ed., vol. 2 (London: John Murray, 1832), 66; Nelson, “From Candolle to Croizat,” 274.

⁴⁴ See *Catalogue de la bibliothèque délaissé par C. J. Temminck*, 2-3; Temminck, *Catalogue Systématique*.

⁴⁵ Van Lynden-de Bruïne, *In vogelvlucht*; Raat, “Humboldt and Temminck”; Stresemann, “Briefwechsel von Temminck mit Hoffmannsegg und Illiger”; “Aus C. J. Temmincks Briefen an H. Lichtenstein”; “Ornithologen-Briefe aus den Jahren 1816 bis 1820.”

the height above the surface of the sea, the temperature during the growing season, the soil and constitution of the mountains, even the degree of longitude, and several other circumstances, have an influence on vegetation."⁴⁶ The British physician and ethnologist James C. Prichard also recognized that on different continents "the vegetable tribes will present, in each respectively, analogies of form and general character; but few, if any, of the same species will be found in localities thus separated."⁴⁷

All agreed with Temminck about the similarity in families and genera composition at the same latitude, but Temminck seems to stand alone in giving much more weight to the recurrence of these groups than to the diversity of species, which he related to the influence of the environment. Temminck's whole theory of animal distribution is based on the types and not on the particular species. It is not surprising, then, that these naturalists interpreted the variation of forms throughout the globe in two entirely different ways. They were looking at geographical distribution from different levels. While Temminck emphasized unity of a widespread form, the type, along the same latitude, Buffon, Humboldt, de Candolle, Wallace and others were surprised about the great diversity of forms (including species and varieties) in regions with the same climate.

The stress on the similarity of the general form of the species horizontally, that is, along certain latitudes in the northern hemisphere, is probably the main reason Temminck arrived at a different conclusion than Buffon. Perhaps his notion that species could not be 'true' natural divisions played a role in focusing on the types. In Britain, Sir John Richardson, the Scottish surgeon and naturalist known for his two famous Arctic expeditions, understood that the validity of Temminck's law depended directly on the taxonomic level one was looking at: the genera or the species. In a report on North American zoology published in 1836, he noted:

Buffon hazarded the remark that none of the animals of the Old World exist in the New, except the few which are capable of propagating in the high northern latitudes. Temminck adduces circumstances which favor a modern opinion almost directly opposed to Buffon's; namely, that all the genera which people the earth (a small number belonging to the polar regions only excepted) are to be found in the equatorial zone, or at least within the tropics; and that the genera are spread abroad by means of analogues or species possessing exactly similar generic characters, which range in the same parallels of latitude, through all the

⁴⁶ Augustin Pyramus de Candolle, *Elements of the Philosophy of Plants: Containing the Principles of Scientific Botany ... with a History of the Science, and Practical Illustrations*, trans. Kurt Polycarp Joachim Sprengel (Edinburgh: W. Blackwood, 1821), 266.

⁴⁷ James Cowles Prichard, *Researches into the Physical History of Man* (London: J. and A. Arch, 1813), 50; Nelson, "From Candolle to Croizat," 271.

degrees of longitude, and that notwithstanding the barrier which a wide ocean may be supposed to interpose. The comprehensiveness of this law will evidently be modified by the number of generic divisions admitted by naturalists, and it will be scarcely tenable if the geographical groups of species be raised to generic rank as has been of late frequently done.⁴⁸

Indeed, whether certain populations were regarded as a genus, a subgenus or a species was a matter in constant dispute. As new exotic species were being described, the width and limits of genera needed constant revision and a great deal of definition. How one delimited a genus or a species affected not only systematics, but also biogeography and even comparative anatomy. This point will be discussed more in depth in the following chapter.

Another question remains that may have colored Temminck's views on biogeography. Could it be that Temminck underestimated the differences between tropical regions because he focused on the northern half of the globe? For Temminck, studying animal distribution patterns was less confusing if one focused on the species of Europe and Asia. He found the Sunda islands too diverse to observe general patterns. These islands were "due to their position and their fertile soils covered by vigorous vegetation, the most favorable place to study the animals of the tropical region of the Old World [...]; while there [in the temperate regions of the Ancient Continent], better than anywhere else, one can obtain firm evidence about the geographical distribution of the species."⁴⁹ Even so, Temminck was not ignorant of the nature of the American fauna. His library included many descriptions of voyages, monographs on American birds and mammals and several natural histories of South America.⁵⁰ He also had at his disposal the Leiden collection, extremely rich in specimens from Southeast Asia, Africa and Central America. It is very unlikely that Temminck's law was written in ignorance of Buffon's law or of the fauna of tropical America. Moreover, the presence of marsupials both in Sulawesi and in South America was for Temminck a confirmation that his law was valid beyond the northern hemisphere: "The *Phalangers* and the *Couscous*, marsupial animals [...], are for the Ancient Continent what the *Opossums* and the *Didelphes* are for the parallel regions in the New World."⁵¹ By focusing on the general morphology of

⁴⁸ John Richardson, "Report on North American Zoology," *Report of the British Association for the Advancement of Science* 5 (1836): 223.

⁴⁹ Coenraad Jacob Temminck, "Coup-d'oeil sur la faune des Iles de la Sonde et de l'Empire du Japon. Discours préliminaire destiné à servir d'introduction à la Faune du Japon," in *Fauna japonica, sive, Descriptio animalium, quae in itinere per Japoniam, jussu et auspiciis, superiorum, qui summum in India Batava imperium tenent, suscepto, annis 1823–1830*, ed. Philipp Franz Von Siebold, vol. 1 (1836), v.

⁵⁰ *Catalogue de la bibliothèque délaissé par C. J. Temminck*, 8-14, 30-34.

⁵¹ Temminck, *Coup-d'oeil général*, vol. 3, 113, 16.

marsupials instead of on individual species, what Temminck inadvertently discerned was their common ancestry, while Buffon's law focused on their posterior evolution and diversification.

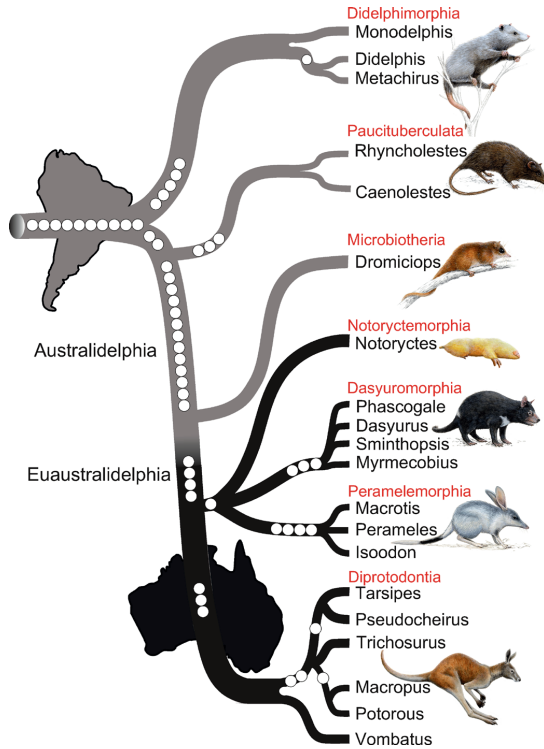


FIGURE 4.2. Phylogenetic tree of marsupials, showing the relation between marsupial forms and their distribution.

On the origin and fixity of species

By the time Temminck formulated his law on biogeography, animal and plant distribution patterns had puzzled naturalists for at least a century. The explanations for the strange phenomena they observed ranged from divine design to more materialistic explanations that comprised universal laws and in which God's role was reduced to creation.⁵² The different approaches depended heavily on one's views about creation,

⁵² For the relation between geographical patterns and the ideas about the origin of the species, see the discussions in Michael Paul Kinch, "Geographical Distribution and the Origin of Life: the Development of Early Nineteenth-century British Explanations," *Journal of the History of Biology* 13, no. 1 (1980); James

the species concept and the relation between environment and varieties. For those accepting that God's intervention was behind all patterns in nature, divine design and ecological factors were important; for those who interpreted nature as a dynamic entity, constantly in flux, ecological and historical causes has a central place in their theories. As Augustin de Candolle put it: "All of the theory of geographical botany rests on the particular idea one holds about the origin of living things and the permanence of species."⁵³

Temminck's type and species concepts are important in understanding his view on issues as complex as the origin and the fixity of the species, as they formed the groundwork for his comprehension of nature. After introducing his law on the geographical distribution of animals, Temminck tried to explain the origin of the types and how they came to be distributed over distant, unconnected regions. The cause of their actual distribution, according to Temminck, could not be migration from one region to the other, because animals migrate and disperse until they encounter a physical barrier.⁵⁴

In this, Temminck agreed with Buffon's statement about the quadrupeds not being able to cross seas or freezing regions, although he made no reference to the origin of these barriers. There had to be another explanation for this remarkable uniformity of type: "It is very probable that the elements that have exerted their influence on creation have produced the same types in the most easterly regions of Asia and in North America, as under the climate of Europe."⁵⁵ In other words, certain *elements* have shaped creation into similar types and into species that share a common form of organization. Temminck did not specify what exactly these elements were, nor did he explain the mechanism by which they could reproduce a type in a particular region on earth. Nevertheless, Temminck explicitly stated that a "pouvoir créateur" was directly accountable for the origin of the types.⁵⁶ Temminck's power of creation was undoubtedly of divine nature: God used ideal types as basic molds for creating species. After all, for Temminck nature was an expression of divine greatness and manufactured according to God's taste, and natural history was "the science that leads man to read

Larson, "Not without a Plan: Geography and Natural History in the Late Eighteenth Century," *Journal of the History of Biology* 19, no. 3 (1986); and Nelson, "From Candolle to Croizat."

⁵³ Augustin Pyramus de Candolle, "Géographie Botanique," in *Dictionnaire des sciences naturelles, dans lequel on traite méthodiquement des différens êtres de la nature, considérés soit en eux-mêmes, d'après l'état actuel de nos connoissances, soit relativement à l'utilité qu'en peuvent retirer la médecine, l'agriculture, le commerce et les arts*, ed. Frédéric Cuvier (Strasbourg: F. G. Levrault, 1820), 417; translated by Nelson, "From Candolle to Croizat," 285.

⁵⁴ Temminck, "Aperçu général," *Fauna Japonica*, vol. 5, 8.

⁵⁵ Temminck, "Aperçu général," *Fauna Japonica*, vol. 5, 8.

⁵⁶ Temminck, "Aperçu général," *Fauna Japonica*, vol. 5, 8; Temminck, "Zoogdieren van Japan," 291.

from the divine pages of the book of nature; that allows him to know the animated and inanimate parts of creation; that unnoticeably elevates his soul to worship the Almighty."⁵⁷

Although the divine origin of nature was not really in dispute in Temminck's time, the accounts of Genesis and Noah's Ark could not explain the actual distribution of species anymore. As naturalists questioned the biblical Flood, another explanation was gaining acceptance: not one, but several centers of creation were the sources of living organisms. This theory of multiple creations, proposed first by the German naturalist Johann Friedrich Gmelin and later adopted and spread by the botanist Karl Ludwig Willdenow, implied that biogeographical regions were the result of independent acts of divine creation: every region had been populated with a set of species by a separate, unique creation. After being created, species dispersed until they encountered a physical barrier. Therefore, that different regions are inhabited by different species was nothing else than the obvious consequence of multiple creations and therefore, one could expect to find transitional areas from one center of creation to another.⁵⁸

Temminck recorded such a transition zone in the island of Timor. A mountain chain divides the island into two regions, each with a separate set of species. There is the Asiatic fauna on the northern side of the mountains, comparable to that of the Greater Sunda Islands and the mainland, and a different fauna on the southern part of the island, with species, Temminck noted, "that belong to a Fauna that seems different, or at least transitory between the species characteristic from the Moluccas and the Australian groups, which appear to belong to a very particular creation."⁵⁹ And as Cuvier had demonstrated, fossils were also testimonies of separate creations, in this case, of now extinct animals. In the *Monographies de mammalogie* Temminck listed the number of known species according to different authors, including forty-two fossil species, remnants of animals that were part of a creation anterior to the present one.⁶⁰ When speaking of the chain of beings, Temminck included extinct species in it, as well as the living ones.⁶¹

Temminck believed in multiple, separate creations in different regions, as did many in his time, and his "pouvoir créateur" can be understood as the divine force that

⁵⁷ Temminck, "Discours préliminaire," *Pigeons et gallinacés*, vol. 1, 6.

⁵⁸ For discussions on the idea of multiple centers of creation, see Larson, "Not without a Plan," 458-59; Kinch, "Geographical Distribution," 96-98.

⁵⁹ Temminck, *Coup-d'œil général*, vol. 3, 168. See also Temminck, "Blik op de dierlijke bewoners," 74-75.

⁶⁰ Temminck, "Discours préliminaire," *Monographies de mammalogie*, vol. 1, ix. Concerning extinction, Temminck accepted Cuvier's catastrophism, which he described as "new and illuminating ideas about the catastrophes that have changed the surface of the globe" (Temminck and Laugier de Chartrouse, "A monsieur le Baron G. Cuvier," *Nouveau recueil de planches coloriées*, vol. 1).

⁶¹ Temminck, "Urotrichus," 1.

created particular types in particular regions on earth each with its unique creation, such as Asia or Australia. He noted that there is a line that runs through Timor, Sulawesi and the Moluccas, which separates the Greater Sunda Islands fauna from the Australian fauna. For example, in Sulawesi there are no elephants, rhinos and tapirs “anymore,” while marsupials and incubator birds can be found on Sulawesi for “the first time” in the East Indies: “The *Phalangers* and the *Couscous*, marsupial animals that are not found anywhere else in the Sunda Islands, are here [in Sulawesi] the first representatives of this group.”⁶² Naturally, “first time” and “anymore” indicated the direction Temminck was following in the description of these island faunas, from West to East, and not a timeline. Temminck saw a clear shift from one fauna to another when moving through different latitudes—in agreement with his law and with the idea of multiple creations.

Temminck did not address the question of the fixity of species directly, but his writings reveal that he believed in the unchanging nature of species. In the first place, for Temminck species belonging to a particular genus were created by God as the physical expressions of the type of that genus, and each species displayed slight morphological variations from the ideal, but it always presented the distinct characteristics of the genus it belonged to. A strong belief in a divine order or design of nature leaves little room for materialistic explanations of nature’s organization. Secondly, and more important, Temminck was certain there were limitations to the amount of variation a species could suffer. Local variations were limited to coloration and size and were due to the environment in which the animals lived. Varieties were not “species in change” nor links between different species, but slight deviations from the original form.⁶³ God created species in several and consecutive acts of creation in different regions, each containing its own distinctive fauna. Temminck’s definition of the type as an ideal morphological plan—distributed by God along particular latitudes—is inextricably linked with a static concept of animal form.

Temminck’s belief in the fixity of the species is perfectly illustrated by his explanation of the special character of the fauna of the Sunda Islands. It relies on the supposition that species cannot change with time. He concluded that if certain species could be found on a particular island of the Indian Archipelago but not on the mainland or on surrounding islands, then that particular island had never been connected to the Asian continent or to the other islands. For example, Sumatra has a different fauna than

⁶² Temminck, *Coup-d’œil général*, vol. 3, 111-13. This shift would later be described by Alfred Russel Wallace and became known as “Wallace’s line.” Wallace’s line runs somewhat differently than the shift Temminck described, between Bali and Lombok instead of between the Lesser Sunda Islands and Timor. See also Camerini, “Evolution, Biogeography, and Maps.”

⁶³ Temminck, “Zoogdieren van Japan,” 292.

the Asian continent, even though the short distance between them could make us expect otherwise.⁶⁴ The difference between Sumatra and the mainland was for Temminck the proof that the archipelago had never been linked to the Asian continent. Likewise, the fauna differs from island to island, proving that Sumatra and Java have never been connected.

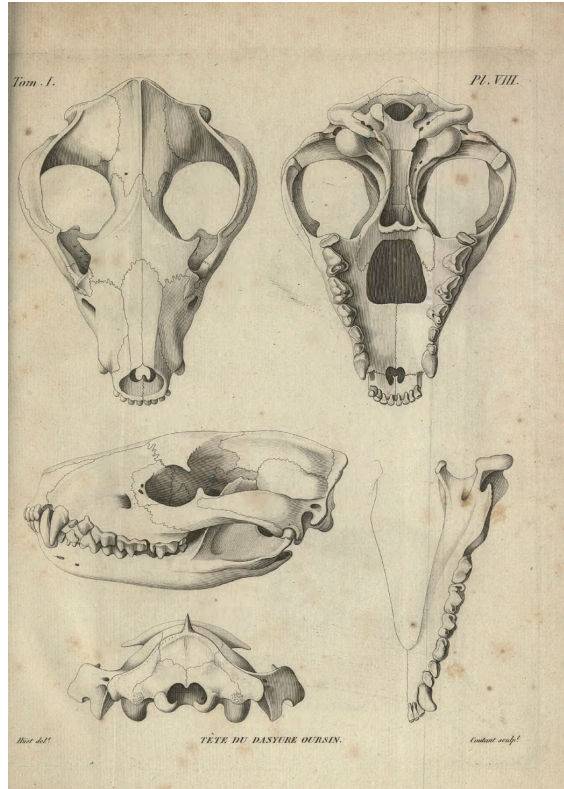


FIGURE 4.3. Illustrations of the skull of the Sulawesi bear cuscus or Sulawesi bear phalanger, described by Temminck in 1824 in his *Monographies de mammalogie*, pl. VIII (1824).

All these facts, Temminck wrote, successfully contradicted the idea, “adopted by some erudites,” of a former attachment of the Sunda Islands to the Indian continent.⁶⁵ These erudites were none others than the French naturalist René-Primevère Lesson and the surgeon Prosper Garnot. They had travelled with Louis Isidore Duperrey on *La*

⁶⁴ Coenraad Jacob Temminck, *Coup-d’oeil général*, vol. 1, 85.

⁶⁵ Temminck, *Coup-d’oeil général*, vol. 2, 93. See also Temminck, “Faune des Iles de la Sonde et de l’Empire du Japon,” *Fauna Japonica*, vol. 1, x.

Coquille during its memorable circumnavigation of the globe between 1822 and 1825. On the basis of their observations, they proposed that in the past Sumatra had been physically linked to the mainland.⁶⁶ If the islands had ever been connected to each other, or to Asia, then animal populations would have happily walked, crawled, swum or flown between them and, after the separation of the islands, the same species would still inhabit Sumatra, Java and the mainland. This argument can only stand if one believes in the fixity of the species: if species can change over time, Sumatra and Java could have been connected, shared the same species, and after their detachment these species could have changed into new ones, leaving both islands with different species. Therefore, if species can change into new ones, the difference in species composition is a meaningless argument for rejecting a former link between the two islands. There is no transmutation of species in Temminck's logic, as their actual form allowed him to interpret the past. This was another reason for Temminck to formulate a law that was the opposite of Buffon's: his belief in the fixity of species. Buffon claimed that species changed generation after generation due to the influence of the environment and of Buffon's interior mold, and their history is linked to that of the earth's surface.⁶⁷ In strong contrast to Buffon, Temminck stressed unity of form: horizontally (of the type along latitudes), of the species (variation is very limited) and in time (species had not changed since their creation).

Temminck's definition of the type was closely linked to his ideas regarding the fixity of species. Alternative definitions led to alternative ideas, as illustrated by Wallace's essay *On the Tendency of Varieties to depart indefinitely from the Original Type*. This was the third of the now legendary papers by Darwin and Wallace read at a meeting of the Linnean Society of London on July, 1, 1858. After presenting his arguments to prove that species evolved by what we now call natural selection, he concluded:

We believe we have now shown that there is a tendency in nature to the continued progression of certain classes of *varieties* further and further from the original type—a progression to which there appears no reason to assign any definite limits—and that the same principle which produces this result in a state of nature will also explain why domestic varieties have a tendency to revert to the original type.⁶⁸

⁶⁶ Louis-Isidore Duperrey, *Voyage autour du monde: exécuté par ordre du roi, sur la corvette de Sa Majesté, la Coquille, pendant les années 1822, 1823, 1824, et 1825* (Paris: Arthus Bertrand, 1826–1830), 19; quoted by Temminck, "Faune des Iles de la Sonde et de l'Empire du Japon," *Fauna Japonica*, vol. 1, x-xi.

⁶⁷ See also Farber, "Buffon and the Concept of Species," 284.

⁶⁸ Charles Darwin and Alfred Wallace, "On the Tendency of Species to form Varieties; and on the Perpetuation of Varieties and Species by Natural Means of Selection," *Journal of the Proceedings of the Linnean Society. Zoology* 3, no. 9 (1858): 62.

For Wallace, variation from the original type was not only potentially unlimited, but it also allowed for the stronger or best-suited varieties to survive and replace the others. Wallace's type was not fixed and certainly not eternal, while Temminck's was both.

Up to 1860, most naturalists studying the distribution of plants and animals were concerned with Buffon's law and the problems posed by the geographical patterns of species. Two of these were extremely puzzling: endemisms and disjunct distributions. Endemic species are those confined to narrow areas, found nowhere else on earth—they are unique and limited to a certain habitat—while species with disjunct distributions are those living in widely separated regions but found nowhere in between, like some Alpine plants that live on the summits of both European and South American mountains. How had these species reached their actual habitats? And why are there no individuals of these species living in the areas in between? These problems could not easily be explained if one believed in a single center of creation, the dispersal following the biblical Flood and the fixity of the species. By combining the idea of multiple centers of creation and subsequent dispersal, naturalists could explain the phenomena of disjunct distributions and, at the same time, offer a plausible theory for the origin of the species.⁶⁹

Michael Kinch explains that there were two main opposite currents to explain all this during the first half of the nineteenth century. At the one extreme, there were naturalists who believed nature was carefully designed by God, who had intentionally distributed animals and plants on the globe as they were now, and whose intervention was the only cause for the patterns they observed. They saw disjunct distributions as proof that there had been multiple centers of creation. At the other extreme, there were those who saw nature governed by general laws effective after God's creation. The geography of plants and animals was a consequence of migration and extinction: dispersion and physical barriers were the causes of disjunct distributions and endemisms.⁷⁰ Even if Temminck's law was the opposite of his colleagues' views, his writings on the Sunda islands and on variations within species suggest that he would have agreed with the first group of naturalists, those who believed that God's plan was behind the structure of nature. Disjunct distributions and endemisms were proof of God's hand in assigning certain types to certain regions. Animals, naturally, would migrate and disperse until either climate or barriers would prevent them from going any further. After 1860, some naturalists like Richard Owen and Louis Agassiz embraced the idea of a divine plan, as they saw everywhere in nature evidence of a universal plan and, consequently, of a designer, while Charles Darwin, Alfred Russel Wallace and Charles Lyell found in

⁶⁹ Larson, "Not without a Plan"; see also Mayr, *The Growth of Biological Thought*, 443.

⁷⁰ Kinch, "Geographical Distribution," 117-19.

evolution through natural selection the answers to the problems posed by the geographical distribution of the species.

The significance of Temminck's work on geographical distribution

Temminck's work on biogeography is of particular interest for two reasons. Firstly, there is Temminck's law, which gives us an idea of where he stood in terms of natural philosophy, and secondly, there is his account of which species could be found where, based on the collections and observations of other naturalists from Malaysia, Indonesia and Japan. And while Temminck's law went practically unnoticed, the descriptive section of his work certainly did not. His works on the fauna of the Dutch East Indies and Japan, when added up to the systematic works, solidified his international status. After all, he provided valuable information to those searching for answers about the geographical distribution of animals—and the fauna of Southeast Asia was particularly compelling. The importance of Temminck's publications on distribution patterns relied not on their philosophical foundations, but on their descriptive sections.

Temminck's law passed through the nineteenth century virtually unheeded. There are hardly any references to it in the scientific literature, with the exception—perhaps the only one—of the note by John Richardson quoted above, emphasizing the role of genera in Temminck's law. As systematics was in constant change, especially at the genus and species levels, Richardson's remarks were prophetic: Temminck's type concept was linked to that of genus, and due to the continual changing and splitting of genera, Temminck's proposition no longer had a well-defined meaning. But there are other reasons for this silence about Temminck's law. First of all, Temminck failed to address in an ordered, clear way the issues that were central in the discussions on biogeography. His law was formulated first in an article written in Dutch, and the second time in the introductory paragraphs to the description of new mammals from Japan, in French. Temminck's law appears very isolated in a text that is actually an introduction to the description of new mammals. Further information that may allow the reader to understand his ideas is scattered through his works. There are no sections or chapters either in the *Fauna Japonica* or in his *Coup-d'oeil général* dedicated exclusively to a detailed theory of distribution. Because he did not construct a logical, comprehensive theory for his observations, it is not really surprising that other naturalists ignored his law—if they were acquainted with it at all—as a serious explanation for the geographical distribution of animals and its related problems. One has to distill Temminck's concepts by laboriously sieving through his works and interpreting them.

An added weakness of his law is that Temminck failed to explain why his law is “less true” for the Southern hemisphere. Was it because of the climate? The geology? Temminck did not say. In addition to the lack of a well-articulated theory, Temminck’s law gained no attention because it relied so heavily on the unity of an ideal plan, represented by the types. This typological thinking began to fade during the first half of the nineteenth century for many naturalists. His types led Temminck to emphasize unity and similarities, while most naturalists were concerned with the overwhelming numbers of different species and their strange distribution patterns.

Temminck also left many interesting questions unanswered, like the origin of the species, the significance of variation, the role of God in creation and the meaning of disjunct distributions and endemisms. He came across strange distributions in the fauna of the Indonesian Archipelago, facts that he labeled as remarkable and yet did not attempt to explain. Unfortunately, he did not engage in a discussion on the possible meaning of these patterns, nor did he specify why they are “important” and “striking.”⁷¹ For instance, after studying the fauna of the Moluccas, he found that the differences in fauna among islands with the same climate and very close to each other were most remarkable. His account of the fauna on these islands is limited to listing which species lived where and even when he did make comparisons between islands, he offered no explanation.⁷²

Temminck did not tackle the problem of disjunct distributions either: why were there individuals of the same species inhabiting distant regions? For example, he noted that the Bongsoe Mountain in Sumatra was populated by Alpine-like flora: “The vegetation on its top carries all the characteristics of the alpine plants of Europe,” including species of *Vaccinium* (a genus of dwarf shrubs that includes cranberries and blueberries) and *Rhododendron* (azaleas and related plants).⁷³ Why are the same plants inhabiting the mountains of central Europe, Sumatra and South America? Have these mountains similar climates and soil? Did God create these species *in situ* in the process of multiple creations? Again, Temminck offered no answers. As Nelson remarked: “causal explanation for Buffon’s law was explored with reference to climate and external factors generally, but there was general agreement that external factors in themselves are insufficient to account for the law—a conclusion most decisively stated, perhaps, by Candolle.”⁷⁴ The failure to quote and contest Buffon’s law in an articulated way, Temminck’s typological thinking and the lack of explanations for endemisms and

⁷¹ Temminck, “Blik op de dierlijke bewoners,” 67.

⁷² Temminck, *Coup-d’œil général*, vol. 3, 235-36.

⁷³ Temminck, *Coup-d’œil général*, vol. 2, 82.

⁷⁴ Nelson, “From Candolle to Croizat,” 286.

disjunct distributions, are the greatest shortcomings of Temminck's theories on animal distribution.

Even though Temminck's law received no attention, his contemporaries attributed great value to his description of the species distribution in the Dutch colonies. Works like the *Faune des Iles de la Sonde et de l'Empire du Japon* and the three-volume *Coup-d'oeil général* were relevant because in them he compared the faunas of the Sunda Islands and Japan with each other and with those of Asia and Australia. The account of the species living on certain islands, but not on others, the report of endemisms on Sulawesi and the Moluccas and the transition from Asian to Australian fauna were all important observations in Temminck's time, even though he was certainly not the first to address this phenomenon. Eberhard A. W. Zimmermann, a German geographer, zoologist and professor of mathematics and natural sciences at the Collegium Carolinum in Braunschweig, published in 1777 in Leiden what could be qualified as the first work on mammal zoogeography. In his *Specimen Zoologiae Geographicae Quadrupedum Domicilia et Migrationes sistens*, he compared the faunas of Asia, the Sunda Islands and Australia, the very same regions that so intrigued Temminck.⁷⁵ Similarly, French naturalists published in the 1840s a series of accounts of the fauna of the region after the discoveries made during the voyages of the *Uranie*, the *Physicienne*, the *Astrolabe* and the *Coquille*.⁷⁶

From Britain, works like Charles Lyell's *Principles of Geology* (1830–1833), James Horsburgh's *India Directory* (1836) and Thomas Horsfield's *Zoological Researches in Java and the Neighbouring Islands* (1824) also dealt with the East Indian fauna. Temminck's works, however, included additional information on the species distribution among the Indian archipelago, facts that were new to naturalists. Particularly important were the newly described species and the meticulous comparison between the Sunda Islands, and the description of the Japanese fauna, until then mostly unknown in Europe. These facts were either completely new or had previously been published in Dutch or in German in journals with a limited distribution, and were therefore not accessible to other naturalists.⁷⁷ For nineteenth-century natural history, the description of the faunas of the

⁷⁵ Temminck was at least acquainted with this work, as it is listed in the *Catalogue de la bibliothèque délaissé par C. J. Temminck*.

⁷⁶ Jules-Sébastien-César Dumont d'Urville, *Voyage de la corvette l'Astrolabe exécuté par ordre du Roi, pendant les années 1826-1827-1828-1829, sous le commandement de J. Dumont d'Urville*, 13 vols. (Paris: J. Tastu, 1830); Duperrey, *Voyage autour du monde: exécuté par ordre du roi, sur la corvette de Sa Majesté, la Coquille, pendant les années 1822, 1823, 1824, et 1825*; Louis Claude Desaulses de Freycinet, *Voyage autour du monde: entrepris par ordre du roi ... exécuté sur les corvettes de S. M. l'Uranie et la Physicienne, pendant les années 1817, 1818, 1819 et 1820*, 4 vols. (Paris: Pillet, 1824?–1844).

⁷⁷ For instance, Temminck, "Zoogdieren van Japan" and "Blik op de dierlijke bewoners"; Salomon Müller, "Aanteekeningen, over de natuurlijke gesteldheid van een gedeelte der westkust en binnenlanden van Sumatra," *Tijdschrift voor natuurlijke geschiedenis en physiologie* 2 (1835) and "Ueber den Character der

European colonies opened a new range of problems, questions and possibilities. All these zoological and botanical treatises, loaded with new information like Siebold's *Fauna and Flora Japonica* or Temminck's *Coup d'oeil* and the *Verhandelingen over de Natuurlijke Geschiedenis der Nederlandsche Overzeesche bezittingen*, were fundamental for the development of new theories, including natural selection and evolution. Temminck's publications in particular were quoted by Andrew Murray in *The Geographical Distribution of Animals*, Jan Baptist Jozef van Doren in the *Mémoire sur les Quadrumanes et les Chéiroptères de l'Archipel Indien* and Alfred Russel Wallace, who had also consulted Temminck's works, especially those on mammals and birds.⁷⁸ Jane Camerini explains how Charles Darwin made use of Temminck's writings when looking for information about the East Indian fauna, among many other sources.⁷⁹ Darwin drew a table comparing the mammals from Sumatra, Java, Borneo, the Moluccas and other islands which, according to Camerini, "was almost certainly made in conjunction with his reading of Temminck's *Coup d'oeil sur la faune des îles de la Sonda et de l'empire de Japon* in 1839."⁸⁰

Because of the paucity of theoretical explanations by Temminck, this analysis of his law on biogeography gives unique insight into his understanding of the concepts of type, genus and species, which stood at the very foundation of all of Temminck's work in systematics. In particular, his definition of genera, his views on variation and, by extension, his practices of zoological nomenclature were crucial for his classifications – and were praised as well as criticized. It is in his reactions to these criticisms that we will gain a deeper understanding of the significance of Temminck's work in particular, and of the advancement of systematics within natural history in general.

Tierwelt auf den Inseln des indischen Archipels, ein Beitrag zur zoologischen Geographie," *Archiv für Naturgeschichte* 12, no. 1 (1846).

⁷⁸ Murray, *The Geographical Distribution of Mammals*, 116, 376; Van Doren, *Mémoire sur les Quadrumanes et les Chéiroptères de l'Archipel Indien*. Wallace referred to Temminck's *Monographies de mammalogie* and the *Verhandelingen over de natuurlijke geschiedenis der Nederlandsche Overzeesche Bezittingen*. See Alfred Russel Wallace, "On the Orang-Utan or Mias of Borneo," *Annals and Magazine of Natural History; Zoology, Botany, and Geology* 17 (1856); "On the Habits of the Orang-Utan of Borneo," *Annals and Magazine of Natural History; Zoology, Botany, and Geology* 18 (1856); *The Malay Archipelago: the Land of the Orang-utan, and the Bird of Paradise*, 1 ed. (New York: Harper & Brothers, 1869).

⁷⁹ Camerini, "Evolution, Biogeography, and Maps," 711.

⁸⁰ Camerini, "Evolution, Biogeography, and Maps," 712.