BUFFON AND THE PROBLEM OF SPECIES

I

There is no chapter of the history of the theory of organic evolution more confused or more controverted than that which relates to the position of Buffon. Upon one point, indeed, nearly all expositors of the Histori e Naturelle are agreed—namely, that Buffon's own expressions on the subject, if taken at their face value, contradict one another. But upon the questions whether his utterances were meant to be taken at their face value; whether, by a due consideration of dates, the contradictions can not be regarded as consecutive steps in a logical progress of doctrine; whether he was in the main a partisan or an opponent of transformism; upon these questions both the biographers of Buffon and the historians of evolutionism are greatly at variance.

The rival interpretations fall into six groups: (1) Older writers of the anti-evolutionary school, such as Cuvier and Flourens, while admitting that (in the words of Flourens) "the ideas of Buffon were constantly subject to profound mutations," were wont to maintain that in the last analysis and in the long run he must be counted among the defenders of the doctrine of immutability of species. Among recent writers Packard gives a similar account; while he recognizes "tentative" evolutionistic utterances in the Histori e Naturelle, he opines that Buffon himself "did not always take them seriously, but rather jotted them down as passing thoughts." (2) One of the earlier French evolutionists, Isidore Geoffroy St. Hilaire, contended that there was no mere fluctuation in Buffon's

1. In his "Histoire Naturelle Generale," Vol. II., 1859. His account is translated in Butler's "Evolution Old and New."
teaching, but simply an orderly movement of thought from one position to another.

Buffon does but correct himself; he does not fluctuate. He goes forward once for all from one opinion to another, from what at the outset he accepted on the authority of another to what he recognized as true after twenty years of research.

The successive phases of opinion through which, according to Isidore Geoffroy, Buffon passed were three. At the beginning of his work (1749) and down to 1756 or later, he "still shared the views of Linnaeus" and affirmed consistently the theory of immutability. From 1761 to 1766 he asserted the hypothesis of variability in an extreme form. Later he became convinced that "in setting himself free from the prevailing notions," he had, "like all other innovators, gone somewhat to the opposite extreme"; and in all his writings subsequent to 1766 he held to a doctrine of "limited mutability," to the "permanence of the essential features" of species and "the variability of details." This division of Buffon's opinions into three periods, of which the middle one was characterized by an extreme evolutionism, has been accepted by a number of later writers. It is apparently adopted by Osborn, though not to the exclusion of other interpretations inconsistent with it. ² (3) By several later writers--such as Samuel Butler, de Lannessan, Giard, Clodd--Geoffroy's scheme of three periods is rejected, and Buffon is declared to have been an evolutionist throughout virtually his whole career as a writer. Those who take this view explain away his apparent self-contradictions by various suppositions. Giard, for example, holds that Buffon began as a transformist, but was led by his difficulties with the ecclesiastical authorities (in 1751) to conceal his real position for a number of years, becoming bolder

². "From the Greeks to Darwin," 130-135.
and more outspoken after 1761, when his fame was securely established. In other words, Giard proposes an alternative division into three periods, in which the middle phase is the least evolutionistic. Samuel Butler, who has taken the most extreme ground of all in favor of the view that Buffon was a whole-hearted evolutionist, endeavors at great length and with much ingenuity to show that all the anti-evolutionary passages in the Histoire Naturelle are ironical. According to this interpretation Buffon must almost be said to have woven a sort of cryptogram into his work. "His irony is not the ill-natured irony of one who is merely amusing himself at other people's expense, but the serious and legitimate irony of one who must either limit the circle of those to whom he appeals, or must know how to make the same language appeal differently to the different capacities of his readers, and who trusts to the good sense of the discerning to understand the difficulty of his position, and make due allowance for it." In other words, Buffon threw in sufficiently frequent affirmations of the immutability of species to deceive, or at least to quiet, the doctors of the Sorbonne, and in the very act of doing so he made it evident to the judicious reader that the opposite conclusion was the one to be accepted.

The three remaining interpretations of Buffon's position are less subtle and ingenious. (4) The author of the most comprehensive recent history of biological theories tells us that, though Buffon "speculated about the origination of one species from another," he did not "especially interest himself in the question of the mutability of species; his too little developed sense for the historical [i.e., the genetic] aspect of

3. In his Evolution Old and New.
nature did not permit him to put clearly before himself such a question as that concerning the origin of species. How should he have done so, since he did not even believe in the existence of species, but recognized only individuals?" (5) Dacqué, in what is at many points the least inaccurate of the histories of evolutionism, declares that Buffon brought forward no more profound ideas than his contemporaries "upon the interconnection of the phenomena of organic nature," though he did something to clarify the conception of geological evolution, and "regarded species as variable within certain limits." (6) Another writer, Landrieu, seems finally to give up as hopeless the attempt to reduce Buffon's utterances to harmony, and coherency. He adds, however, that in spite of these inconsistencies, "Buffon retains the indisputable honor of having been the first zoologist to admit the possibility of specific variations due to environmental influences and extending beyond the limits of species."

All of these accounts of the matter seem to me to be either inadequate or erroneous, though all may be said in some measure to be founded on fact. Most of them—especially of the more recent ones—wholly ignore two essential considerations in relation to Buffon's biological conceptions, in the light of which all that he wrote must be interpreted. In attempting to present a more adequate and more correct analysis of Buffon's opinions, I shall be obliged to tax the reader's patience with many and lengthy citations. Where there has been so much disagreement, it is necessary to present the proofs for nearly every statement propounded. And where so much error has arisen through the citation of brief passages

5. Der Descendenzgedenke u. seine Geschichte, 1903—a little book less known than it deserves to be.

6. In his "Lamarck, fondateur de l'évolution," 1909, pp. 275-283. May I improve this occasion to express the hope that both French and English writers may some day be broken of the habit of talking of "evolution" when they mean "evolutionism"? Both languages chance to be provided with a suffix for distinguishing a theory which affirms, or relates to, a given fact from the fact itself; it seems a pity to throw away this instrument of linguistic precision. It is surely absurd (not to say profane) to speak of Lamarck or any other mortal as "the founder of evolution"; or of the eighteenth century as "the beginning of evolution."
in disregard of their contexts, it is important that pains be taken to quote or summarize so much of each text as appears to be in any way relevant to the question under consideration.

1. The first volume of the great treatise (1749) opened with a preliminary disquisition on the methodology of the science, a "Discours de la maniere d'étudier et de traiter l'histoire naturelle." In this Buffon gave a salutary emphasis to the demand for a more "philosophical" way of studying botany and zoology than had been exemplified by Linnaeus and Tournefort and the other great systematists. Description and classification, Buffon insisted, were the least part, though a necessary part, of "natural history."

We ought to try to rise to something greater and still more worthy of occupying us—that is to say, to combine observations, to generalize the facts, to link them together by the force of analogy, and to endeavor to attain that high degree of knowledge in which particular effects are recognized as dependent upon more general effects, nature is compared with herself in her larger processes, and thus ways are opened before us by which the different parts of physical science may be perfected. For success in the former sort of study there are needful only a good memory, assiduity and careful attention; but for the sort of which we are here speaking other qualities are requisite: breadth of view, steadiness of vision, a power of reasoning formed by the practice of reflection even more than by learning. For such study, in short, a man must have that quality of mind which enables him to grasp remote relations between things, to bring them together, and thereby to form a body of reasoned conclusions, after having duly estimated similarities and weighed probabilities.

But these judicious and stimulating, if slightly vague, appeals for the conversion of natural history into a science of causal relations and generalized laws, were not the principal purpose of the preliminary discourse. The thought of Buffon at the time when he wrote that essay seems to have been dominated above all by a single idea, which was also
one of the two or three ruling ideas of the whole of the first half of the eighteenth century—namely, the Leibnitian "principle of continuity" (i.e., continual). In the intellectual fashions of this period, next to the blessed word "Nature" the most sacred phrase was "the Great Chain of Beings"; indeed, one of the truths that men was supposed to know most surely about Nature was that she "makes no leaps." In the form, especially, of the neo-Platonic and Spinozistic metaphysical assumption that all possible forms must exist, the principle was much older than the philosophy of Leibniz; but it owed to him and his disciples a more definite formulation and a greatly increased popular currency. It declared that all entities are arranged in a graded scale of similarity, so that for every being that exists there also exists some other (in the strict version of the principle, one and only one other) from which its difference is infinitesimal, i.e., less than any assignable difference. A typical statement of the doctrine is Bonnet's:

Between the lowest and the highest degree of corporeal or spiritual perfection there is an almost infinite number of intermediate degrees. The series of these degrees constitutes the Universal Chain. It unites all beings, binds together all worlds, embraces all spheres. One Being alone is outside of this chain, and that is He who made it...There are no breaks (brevia) in nature; all is graduated, everything shades off into the next thing. If, between any two beings whatever, there existed a gap, what would be the reason of the transition from the one to the other? There is, therefore, no being above or below which there is not some other that approximates it with respect to some characters and diverges from it with respect to others.

All this (as Bonnet's language intimates) was held by the

7. This implied that there must be one, and can be only one, sample of every possible kind or degree of entity. To consider Leibniz's attitude toward this form of the principle would involve too much technical metaphysics.

Leibnian philosophy to be logically implied by the still more fundamental "principle of sufficient reason." For if the gradations found in nature were discontinuous, if between any two beings an intermediate type were logically capable of existing, but actually non-existent, the universe would stand convicted of irrationality. A thing for the existence of which there was just as much "reason" as there was for the existence of certain other things would have failed of realization, while the others arbitrarily enjoyed the privilege of actuality. The principle of continuity owed its vogue in part, also, to the influence of the Leibnian calculus, which had brought infinitesimals and the notion of the continuum peculiarly into fashion.

It was, then, the application of this principle to natural history that was Buffon's main object in his preliminary discourse. The consequences of it, when it was applied in this field, were simple and evident and drastic: there can be no such thing as a "natural," or even a consistent "system" of classification, since there are no sharp-cut differences in nature, and since, therefore, species and genera are not real entities but only figments of the imagination. It is easy, Buffon wrote, to see the essential fault in the work of the systematists, the inventors of "methods" as a class.

It consists in an error in metaphysics in the very principle underlying these methods. This error is due to a failure to apprehend nature's processes, which take place always by gradations (nuances), and to the desire to judge of a whole by one of its parts.9

Man, placing himself at the head of all created things and then

observing one after another all the objects composing the universe,

will see with astonishment that it is possible to
descend by almost insensible degrees from the most
perfect creature to the most formless matter; ... he
will recognize that these imperceptible shadings are
the great work of nature; he will find there—these
gradations—not only in the magnitudes and the forms,
but also in the movements, in the generations and
the successions, of every species. 10 If the meaning
of this idea be fully apprehended, it will be clearly
seen that it is impossible to draw up a general
system, a perfect method, for natural history...
For in order to make a system or arrangement, every-
thing must be included, and the whole must be divided
into different classes, these classes into genera,
and the genera into species—and all this according
to an order in which there must necessarily be some-
thing arbitrary. But nature proceeds by unknown
gradations, and consequently can not wholly lend
herself to these divisions—passing, as she does,
from one species to another species, and often from
one genus to another genus, by imperceptible shadings;
so that there will be found a great number of inter-
mediate species and of objects belonging half in one
class and half in another. Objects of this sort,
to which it is impossible to assign a place, necessarily
render vain the attempt at a universal system. 11

In short, the whole notion of species is inconsistent with the conception

of nature as a graded continuum of forms in which there are no breaks.

In general, the more one increases the number of
one's divisions, in the case of natural products,
the nearer one comes to the truth; since in reality
individuals alone exist in nature, while genera,
orders, classes, exist only in our imagination. 12

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10. These words are Buffon's nearest approach in the introductory dis-
course to a suggestion of the mutability of species. De Lannessan
has interpreted them as an affirmation of transformism; but they
are too vague to justify such a construction.

11. Vol. I., 1749, p. 13. Much the same thing had, however, been said
by Ray over sixty years before; cf. 1686, I., p. 50.

The vogue of the principle of continuity in the eighteenth century was, unquestionably, an important influence tending to prepare men's minds for the acceptance of the conception of evolution; but the two doctrines were by no means synonymous, nor did the adoption of the former necessarily imply adherence to the latter. *The lex continui* is historically important because it led to one of the early notable departures in modern thought from what may be called a Platonistic habit of mind, that had, in a hundred subtle ways, dominated most European philosophy and science for many centuries; it meant, in some degree, the abandonment of the fashion of thinking of the universe as tied up in neat and orderly parcels, the rejection of rigid categories and absolute antitheses, as inadequate instruments for the description of the complexity and fluidity and individualizedness of things. In other words, the principle of continuity, though itself the product of the extreme of philosophical rationalism, tended in a mild way towards a sort of antirationalism, towards a distrust of over-sharp distinctions and oversimple conceptions, towards a sense of a certain incommensurability between the richness of reality and the methods of conceptual thought. And in the nineteenth century this same tendency, in vastly more extreme forms, has been far more conspicuously furthered by the influence of the doctrine of evolution. But the idea of continuity as generally held in the time of Buffon had no reference to temporal sequences and by no means involved, in the minds of those who accepted it, any definite belief in the descent of what are commonly called species from other species.  

13. This fact has often been overlooked by interpreters of eighteenth century writers. When we find such a writer saying that "nature passes from one species to another by gradual and almost imperceptible transitions," it is by no means safe to assume that the phrase contains any reference to genealogical transitions, or that the writer meant by his words to affirm the transformation of species through the summation of slight individual variations. Misapprehension upon this point has caused some eighteenth century authors to be quite undeservedly set down as evolutionists.
supposition of continuous gradations and imperceptible transitions had been explicitly brought to bear upon genetic problems in biology, it would naturally though not necessarily have suggested some sort of theory of descent. It did, in fact, in combination with what I have called the principle of plenitude, lead several important eighteenth-century writers—Leibniz, Bonnet, Akenside, Robinet—to adopt a theory of the progressive advance of organic types in the course of cosmic history, which fore-shadowed, though it did not amount to, the hypothesis of organic evolution.

But it seems to have been taken in an essentially static sense by Buffon in the introductory discourse in his first volume. A single obscure phrase, which I have already quoted, might be regarded as hinting at the conception of organic evolution, if the general tenor of the essay lent any confirmation to such an interpretation. But nowhere else in this writing is it even remotely suggested that the conception of the continuity of forms involves the conception of the descent of so-called species from one another. It is scarcely conceivable that if Buffon had had before his mind so momentous a new idea as that of evolution, he should not have contrived to give a far plainer intimation of it than a single vague remark that imperceptible gradations are found not only in the forms but also in the generations and the successions of every species. At this time, at all events—whatever he may have been later—Buffon was fairly outspoken in the expression of even heterodox hypotheses; it was only subsequently that he was condemned by the Sorbonne, on account of opinions propounded in his Théorie de la Terre, contained in the same volume as the

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preliminary discourse. It is significant, moreover, that at this date he saw no hint of any evolutionary significance in the homologies of the vertebrate skeleton; he had as yet learned nothing from comparative anatomy. This is shown in the argument by which he defends his own method of arranging species—a method which wholly ignored anatomical considerations and merely proceeded from the more familiar to the less familiar animals.

Is it not better to make the dog, which is fissiped, follow (as he does in fact) the horse, which is soliped, rather than have the horse followed by the zebra, which perhaps has nothing in common with the horse except that it is soliped?... Does a lion, because it is fissiped, resemble a rat, which is also fissiped, more closely than a horse resembles a dog?15

It is probable, then, that in writing the opening discourse of his great work Buffon was innocent of any idea of organic evolution; it is certain that he did not convey that idea in any such way that a reader of his time might be expected to recognize it. Nor did he make any use of the conception of the descent of species in his Théorie de la Terre, of the same date—where he might naturally have been expected to introduce the doctrine, if he held it; on the contrary he implies (p. 197) the equal antiquity of all species—though he does so in a way which, I confess, might plausibly be taken as ironical. The truth is that when under the influence of the principle of continuity Buffon's mind overshot the problem of the origin of species altogether. There were no such things as species; upon this point he was clear. There was therefore no need of explaining their genesis. As for the further question, how successive generations of offspring are related in form to their forebears,

that was a question upon which the principle of continuity had, strictly speaking, nothing to say. That offspring varied somewhat, and usually slightly, from their parents everyone knew; to this extent the conformity of the laws of heredity to the law of continuity was a commonplace of every-day observation. Beyond this, no definite genetic or embryological consequences seemed necessarily to follow from the maxim *natura non facit saltus*.

The most important thing, however, to remark concerning Buffon's position in his first volume is that it is a position which he speedily abandoned, and to which he never returned. Its most characteristic point was the contention that nature knows only individuals and that species are *entia rationis* merely. The most characteristic point of nearly all his subsequent references to the subject is the contention that species are real entities, definable in exact and strictly objective terms, and necessary to take account of in any study of natural history.

This change already was manifest in the second volume published in the same year as the preliminary discourse (1749). In this volume Buffon propounded his celebrated definition of species, which was destined to have so great an influence upon the biological ideas of the later eighteenth century.

We should regard two animals as belonging to the same species if, by means of copulation, they can perpetuate themselves and preserve the likeness of

16. Râdl's account, already quoted, of Buffon's attitude towards transformation and towards the conception of species, is apparently based chiefly upon the first volume. For virtually all of Buffon's views, except his early and quickly repudiated one, Râdl's statement is almost the exact reverse of the truth.
the species; and we should regard them as belonging to different species if they are incapable of producing progeny by the same means. Thus the fox will be known to be a different species from the dog, if it proves to be the fact that from the mating of a male and a female of these two kinds of animals no offspring is born; and even if there should result a hybrid offspring, a sort of mule, this would suffice to prove that fox and dog are not of the same species—\textit{inasmuch as this mule would be sterile (ne produirait rien)}. For we have assumed that, in order that a species might be constituted, there was necessary a continuous, perpetual, and unvarying reproduction (une production continue, perpetuelle, invariable)—similar, in a word, to that of the other animals.\textsuperscript{17}

This language, it will be observed, implies not only that species are real entities, but also that they are constant and invariable entities. The same implication may be found again later in the volume; Buffon thus concludes the exposition of his embryological hypotheses—which embraced a theory of pangenesis:

\begin{quote}
There exists, therefore, a living matter, universally distributed through all animal and vegetal substances, which serves alike for their nutrition, their growth and their reproduction...Reproduction takes place only through the same matter's becoming superabundant in the body of the animal or plant. Each part of the body then sends off (renvois) the organic molecules which it can not admit. Each of these particles is absolutely analogous to the part by which it is thrown off, since it was destined for the nourishment of that part. Then, when all these molecules sent off by all the parts of the body unite, they necessarily form a small body similar to the first, since each molecule is similar to the part from which it comes. It is in this way that reproduction takes place in all species...There are, therefore, no preexisting germs, no germs contained within one another \textit{ad infinitum}; but there is an organic matter, always active, always ready to be shaped and assimilated and to produce beings similar to those which receive it. Animal or vegetable species, therefore, can never, of themselves, disappear (s'épuiser). So long as any individuals
\end{quote}

\textsuperscript{17} \textit{Hist. Nat.}, Vol. II., 1749, p. 10.
belonging to it subsist, the species will always re-
main wholly new. It is as much so today as it was
three thousand years ago.18

The reference here is primarily to the continuance rather than
the invariability of species. But the latter seems also to be implied;
and certainly Buffon does not improve the opportunity to introduce a hint
of the doctrine of mutability—as he could hardly have failed to do if
he had at this time held that doctrine and had been desirous of propa-
gating it. It must be remembered that these passages also were written
before Buffon's opinions had been censured by the Sorbonne.

No account of Buffon's position in the history of biology can be
other than misleading which fails to note the decisive significance, for
nearly all of his positions from the second volume onward, of the peculiarly
Buffonian criterion of identity and diversity of species. Unless this
criterion (and the implied distinction between species and varieties,
which latter term covers many Linnaean species) be borne in mind, most
of the pages in the Histoire Naturelle which have an evolutionistic sound
are likely to be misinterpreted. This is what has happened in a number
of the studies of Buffon's relation to evolutionism. The error is especially
conspicuous in Samuel Butler's Evolution Old and New. Butler has devoted
nearly one hundred pages to a review of Buffon's utterances on the subject;
yet he nowhere lets his reader know that Buffon was the propounder of a
new definition of species, which set up a radical distinction between
species and varieties, and implied that a species was a definite, objec-
tive, "natural" entity. The oversight is not due to any neglect of

Buffon's to emphasize and reiterate his definition. He recurs to it frequently in later volumes. His sense of its importance was such that the question of hybridism and of the limits of fertility in cross-breeding was one of the few subjects which he can be said to have studied experimentally on his own account. He writes, for example, in 1755:

We do not know whether or not the zebra can breed with the horse or ass; whether the large-tailed Barbary sheep would be fertile if crossed with our own; whether the chamois is not a wild goat;...whether the differences between apes are really specific or whether the apes are not like dogs, one species with many different breeds....Our ignorance concerning these questions is almost inevitable, as the experiments which would settle them require more time, care and money than can be spared from the fortune of an ordinary man. I have spent many years in experiments of this kind, and will give my results when I come to speak of mules. But I may as well say at once that I have thrown but little light on the subject and have been for the most part unsuccessful.19

II

We have thus far noted three generally disregarded but fundamental facts concerning Buffon's opinions about the nature of species. The first fact is that in his preliminary discourse in the first volume of the Histoire Naturelle, in which he sought to apply the Leibnitian principle of continuity to natural history, Buffon's emphasis upon the continuity of the gradations between species probably had no evolutionary implications. The second fact is that the principal doctrine of this discourse is to the effect that only individuals exist in nature, while species exist only by grace of the human imagination, which, aided by human ignorance, sees sharp lines of cleavage among organisms where no

19. Vol. V., p. 63. The passage is given by Butler, but he shows no sense of its general significance.
such lines are. The third fact is that this doctrine was already tacitly but decisively abandoned in Buffon's second volume, where he represents species as real and well-marked natural entities, their limits being determined by the test of the sterility of the products of cross-breeding. There are, indeed, many later passages where the old phraseology incongruously recurs; but it recurs in contexts in which the reality of species is expressly insisted upon.

2. When the fourth volume of the *Histoire Naturelle*—the first dealing specifically with the lower animals—appeared in 1753, four years after the first three, Buffon's departure from the notions set forth in the preliminary discourse became still more evident. He had by this time, in the first place, been greatly impressed by the homologies in the structure of the vertebrates; he had come to see some significance in those facts of comparative anatomy which his own treatise—though more through the contributions of Daubenton than through his own—was for the first time setting in a clear light. The existence throughout at least all the immensely diverse vertebrate forms of an underlying unity of type, Buffon was, I suppose, the first to bring forcibly to the attention of naturalists and philosophers, as a fact calling for serious consideration and explanation.

If we choose the body of some animal or even that of man himself to serve as a model with which to compare the bodies of other organized beings, we shall find that...there exists a certain primitive and general design, which we can trace for a long way....Even in the parts which contribute most to give variety to the external form of animals, there is a prodigious degree of resemblance, which irresistibly brings to our mind the idea of an original pattern after which all animals seem to have been conceived. What, for example, can at first seem more unlike man than the horse? Yet when we compare man and horse point by point and detail by
detail, is not our wonder aroused rather by the resemblances than by the differences to be found between them?...It is but in the number of those bones which may be regarded as accessory, and in the lengthening or shortening or mode of attachment of the others, that the skeleton of the horse differs from that of the human body....The foot of the horse (as M. Daubenton has shown), in appearance so different from the hand of man, is nevertheless composed of the same bones, and we have at the extremities of our fingers the same small hoof-shaped bone which terminates the foot of that animal. Judge, then, whether this hidden resemblance is not more marvelous than any outward differences, whether this constancy to a single plan of structure—which we can follow from man to the quadrupeds, from the quadrupeds to the cetacea, from the cetacea to birds, from birds to fishes, from fishes to reptiles—whether this does not seem to show that the Creator in making all these used but a single main idea, though varying it in every conceivable manner—so that man might admire equally the magnificence of the execution and the simplicity of the design.

But consideration of the anatomical homologies did not lead Buffon merely to pious reflections. He saw clearly and unequivocally declared that this unity of type forcibly suggests the hypothesis of community of descent. To one who considers only this class of facts, he wrote:

Not only the ass and the horse, but also man, the apes, the quadrupeds, and all the animals, might be regarded as constituting but a single family....If it were admitted that the ass is of the family of the horse, and differs from the horse only because it has varied from the original form, one could equally well say that the ape is of the family of man, that he is a degenerate (degenerè) man, that man and ape have a common origin; that, in fact, all the families, among plants as well as animals, have come from a single stock; and that all animals are descended from a single animal, from which have sprung in the course of time, as a result of progress or of degeneration, all the other races of animals. For if it were once shown that we are justified in establishing these families; if it were granted that among animals and plants there has been (I do not say several species) but even a single one,
which has been produced in the course of direct
descent from another species; if, for example, it
were true that the ass is but a degeneration from
the horse—then there would no longer be any limit
to the power of nature, and we should not be wrong
in supposing that, with sufficient time, she has
been able from a single being to derive all the
other organized beings.

Buffon thus presented the hypothesis of evolution with entire
definiteness, and indicated the homological evidence in its favor.
But did he himself regard that evidence as conclusive, and therefore
accept the hypothesis? The passage cited is immediately followed by
a repudiation, ostensibly on theological grounds, of the ideas which
he has been so temptingly presenting.

But not! It is certain from revelation that all
animals have participated equally in the grace of
direct creation, and that the first pair of every
species issued full formed from the hands of the
Creator.20

This repudiation has been regarded as ironical, or as inserted
merely pro forma, by those interpreters of Buffon who have made him out
a thorough-going evolutionist. Unfortunately, nearly all these writers—
dealing somewhat less than fairly with their readers—have failed to men-
tion that his rejection of the evolutionary hypothesis was not put forth
by him as resting exclusively upon these religious considerations. If
the words just quoted stood alone, it would, indeed, be scarcely possible
to take them seriously. But they do not stand alone; they are directly
followed by arguments of quite another order against the possibility of
the descent of one real species from another; and the essence of the most
emphasized of these arguments lies in the Buffonian conception of the

nature of species, already expounded in the second volume. In other words, the fact of the sterility of hybrids, and certain other purely factual considerations, were urged by Buffon as conclusive objections against the theory of descent.

Specifically, his arguments against evolution are three: (1) Within recorded history no new true species (in his own sense of the term) have been known to appear. (2) There is one entirely definite and constant line of demarcation between species; it is that indicated by the infertility of hybrids.

This is the most fixed point that we possess in natural history. No other resemblances or differences among living beings are so constant or so real or so certain. These, therefore, will constitute the only lines of division to be found in this work.

But why, it may be asked, should the sterility of hybrids be a proof of the wholly separate descent of the two species engendering such hybrids? This question Buffon does not neglect to answer. An "immense and perhaps an infinite number of combinations" would need to be assumed before one could conceive that "two animals, male and female, had not only so far departed from their original type as to belong no longer to the same species—that is to say, to be no longer able to reproduce by mating with those animals which they formerly resembled—but had also both diverged to exactly the same degree, and to just that degree necessary to make it possible for them to produce only by mating with one another." The logic of this is to me, I confess, a trifle obscure; but it is evident that Buffon conceived that the evolution from a given species of a new species infertile with the first could come about only through a highly improbable conjunction
of circumstances. (3) Buffon's third reason for maintaining the fixity of species is the argument from the "missing links."

If one species had been produced by another, if, for example, the ass species came from the horse, the result could have been brought about only slowly and by gradations. There would therefore be between the horse and the ass a large number of intermediate animals. Why, then, do we not today see the representatives, the descendants, of these intermediate species? Why is it that only the two extremes remain?

Taking these three arguments into account, then, Buffon arrives at this conclusion:

Though it can not be demonstrated that the production of a species by degeneration from another species is an impossibility for nature, the number of probabilities against it is so enormous that even on philosophical grounds one can scarcely have any doubt upon the point. 21

However plausibly Buffon's incidental expressions of deference to the testimony of revelation may be regarded as perfunctory and insincere, it would be absurd to suppose that he was also ironical in these legitimate and ostensibly scientific (however poor) arguments for the fixity of species—arguments which are closely connected with that conception of the nature of species which was perhaps his most influential personal contribution to the biological ideas of his time. We must conclude, then, that, while he clearly envisaged the hypothesis of evolution as early as 1753, and recognized that there was some probable evidence in its favor, he then seriously believed that the preponderance of probability was enormously against it. It is certain that contemporary readers must have understood

21. These, the most definite and decisive words on the subject to be found anywhere in Buffon's writings, have been strangely disregarded by most of those who have discussed his attitude towards evolutionism. Samuel Butler can scarcely be acquitted of suppressing the passage, fatal to his theory. For he quotes in full the opening part of the passage, leaving off abruptly at the point where Buffon begins to introduce his serious objections to the theory of descent. Cf. Evolution Old and New, p. 91.
this to be his position.

The same doctrine—that true species, as determined by the sterility of hybrids, are real natural entities and constant units amid the otherwise infinitely variable phenomena of organic nature—is repeated and emphasized many times in subsequent volumes of the *Histoire Naturelle.* Thus in volume five (1755) Buffon—trying to retain as much of the principle of continuity as could be made consistent with his present view—writes as follows:

> Although animal species are all separated from one another by an interval which nature can not overstep, some of them seem to approximate one another by so great a number of relations, that there remains between them only so much of a gap as is necessary to establish the line of separation.22

In the same volume he insists upon the equal antiquity of all real species, in the very passage in which he emphasizes the possibility of a wide range of variation within the species:

> Though species were formed at the same time, yet the number of generations since the creation has been much greater in the short-lived than in the long-lived species; hence variations, alterations, and departures from the original type, may be expected to have become far more perceptible in the case of animals which are so much farther removed from their original stock.23

This is advanced as a partial explanation of the extreme diversity of breeds in the canine species: the dog is a short-lived animal and has therefore been capable of a relatively great degree of diversification.

A little later (in Vol. VI., 24 1756) Buffon declares that "nature

22. P. 59 (italics mine).
23. P. 194
24. P. 55.
imprints upon every species its inalterable characters." In 1765—
that is, at precisely the period during which we are told that Buffon
"was expressing very radical views on the mutability of species"—we
find him (in his "Second View of Nature," Vol. XIII.) giving his most
extreme expression to the doctrine of the reality and constancy of genuine
species. Here the language of the preliminary discourse concerning the
relative significance in nature of the species and the individual has
come to be completely reversed.

   An individual, of whatever species it be, is nothing
   in the universe; a hundred, a thousand individuals are
   nothing. Species are the only entities of nature (les
   seuls êtres de la nature)—perduing entities, as
   ancient, as permanent, as nature herself. In order to
   understand them better, we shall no longer consider
   species as merely collections or series of similar in-
   dividuals, but as a whole independent of number, inde-
   pendent of time; a whole always living, always the
   same; a whole which was counted as a single unit among
   the works of the creation, and which consequently makes
   only a single unit in nature....Time itself relates
   only to individuals, to beings whose existence is fugi-
   tive; but since the existence of species is constant,
   it is their permanence that constitutes duration, the
differences between them that constitute number....Let
us then give to each species an equal right at nature's
   table; they are all equally dear to her, since she has
given to each the means of existing, and of enduring as
long as she herself endures. 25

   This sort of rhetoric is not the dialect of an evolutionist; it
is almost that of a Platonist. And there is more in plainer language to
the same effect:

   Each species of both animals and plants having been
created, the first individuals of each served as
models for all of their descendants....The type of each
species is cast in a mold of which the principal features
are ineffaceable and forever permanent, while all the
accessory touches vary. 26

Many years later still, in 1778, there appeared the sub-division of the *Histoire Naturelle* which Buffon's contemporaries regarded as his most brilliant and most significant work—the *Époques de la Nature*. This was a resumption on a grander scale, and upon new principles, of the task attempted in the *Theory of the Earth* in the first volume, thirty years before—an outline of planetary evolution. To the diffusion of evolutionary ways of thinking in the larger and vaguer sense, this treatise was a contribution of capital importance. Into the details of Buffon's geology I do not wish to enter here. But it is worth while for our purpose to recall one or two striking facts about the *Époques.*

In it the writer whom a recent German historian of biology has declared to have had a too little developed sense for the historical or genetic aspect of nature, attempted, in a far more comprehensive, more definite and more impressive way than any of his predecessors, to write the history of the gradual development of our planet from the time when, an incandescent ball, it was separated from the sun. The task was, of course, undertaken prematurely; but Buffon not only made the need of its eventual achievement evident, but also indicated two of the essential means by which it was to be accomplished: the study of present phenomena which can throw light upon the past processes through which existing conditions have been brought about; and the study of those natural "monuments which we ought to regard as witnesses testifying to us concerning the earlier ages."

He insisted, moreover, with the utmost plainness upon (as it was then regarded) the extreme antiquity not only of the earth, but also of organic life. And in doing so he showed himself not at all disposed any longer to permit "revelation" to settle scientific questions. "How," he writes,
"Some one will ask me, do you reconcile this vast antiquity which you ascribe to matter with the sacred traditions, which give to the world only some six to eight thousand years? However strong be your proofs, however evident your facts, are not those reported in the holy book more certain still?" Buffon replies that he has all possible respect for scripture, but that it always pains him to see it used in this way. Doubtless there is no real conflict between its testimony and that of science; and he thereupon introduces one of the long series of reconciliations of Genesis and geology. The six days were not really days, but long periods of time, and so forth. But in any case, he concludes, the Bible was originally addressed to ignorant men at an early stage of civilization, and was adapted to their needs and their intelligence. Its science was the science of the time, and ought not to be taken too literally. Finally, it is to be noted that in the "Époques" Buffon ceased to talk of the simultaneous creation of all species, and advanced the doctrine of the gradual appearance of different sorts of animals in conformity with geological conditions.

If, then, Buffon was desirous of inculcating the theory of the mutability of species, here was the place in which, above all others, he might be expected to do so fully and unequivocally. But here once more we find him reiterating the substance of his old doctrine:

A comparison of these ancient monuments of the earliest age of living nature with her present products shows clearly that the constitutive form of each animal has remained the same and has undergone no alteration of its principal parts. The type of each species has not changed; the internal mold has kept its shape without variation. However long the succession of time may be conceived to have been, however numerous the generations that have come and gone, the individuals of each kind (genre) represent to-day the forms of those of the earliest ages—especially in the case of the larger
species, whose characters are more invariable and whose nature is more fixed.\textsuperscript{27}

By the "larger species" here, Buffon means those of greater size, such as the elephant and hippopotamus; and when he says that these are "especially" invariable, he means, as the whole context shows, not that any other species ever departs from its specific type, but that in these larger creatures even the "accessory touches" have been comparatively little altered.

Thus, in a long series of passages, from 1753 on, we find Buffon reiterating with explicitness and emphasis the same teaching, which has, for him, its principal bases in two of his most cherished conceptions; namely, in his conviction that the sterility of hybrids shows that species are real "entities of nature"; and in his embryological theory of "organic molecules" and of the "internal mold" which "casts into its own shape those substances upon which it feeds" and "can operate in the individual only in accordance with the form of each species." One of the first of modern naturalists to make the idea of organic evolution familiar to his contemporaries and to discuss it seriously, Buffon repeatedly rejected that theory, at all periods of his career; and he did so, not from timidity merely nor from an affectation of deference to scriptural authority, but upon reasoned grounds which he plainly stated and had every appearance of presenting as conclusive. Yet it is also undeniable, as will presently be seen, that he did not maintain this negative position without occasional waverings and doubts and at least one clear, though possibly inadvertent, self-contradiction.

\textsuperscript{27} Hist. Nat., Supp., V., p. 27.
3. In spite of his habitual emphasis upon the constancy of true species, Buffon insisted more than any of his predecessors, and more, perhaps, than any of his contemporaries, except Maupertuis and Diderot, upon the variability of organisms and the potency of the forces making for their modification.

Though nature appears always the same, she passes nevertheless through a constant movement of successive variations, of sensible alterations; she lends herself to new combinations, to mutations of matter and form, so that today she is quite different from what she was at the beginning or even at later periods. 28

The passage is from one of Buffon's later writings; but its close counterpart is to be found as early as 1756:

If we consider each species in the different climates which it inhabits, we shall find perceptible varieties as regards size and form; they all derive an impress to a greater or less extent from the climate in which they live. These changes are made slowly and imperceptibly. Nature's great workman is Time. He marches ever with an even pace, and does nothing by leaps and bounds, but by degrees, gradations and successions he does all things; and the changes which he works—at first imperceptible—become little by little perceptible, and show themselves eventually in results about which there can be no mistake. 29

For the most part these changes were clearly represented by Buffon as taking place only within the limits of species; they amounted merely to the formation of new "races" or varieties. Since his criterion of identity of species (the possibility of interbreeding) did not essentially depend upon morphological similarity, he could with consistency suppose the descendants of a given pair to have departed to a very great (though not to an indefinite) degree, in the course of ages, from the form and external characters of their ancestors. It was, in other words,

28. Supp., V., 1773, p. 3.
29. Vol. VI., pp. 59-60. I have borrowed Butler's excellent rendering of this passage.
characteristic of his biological system that he set up an absolute distinction between species and varieties, gave an extreme extension to the notion of a variety, and sought to reduce the number of separate species as much as possible, by assuming—until the establishment of the sterility of the hybrids should prove the contrary—that most of the Linnaean species were merely varieties descended from a relatively small number of original specific types. Near the close of his essay "De la dégénération des animaux" (1766), Buffon writes:

To account for the origin of these animals [certain of those found in America] we must go back to the time when the two continents were not yet separated and call to mind the earliest changes which took place in the surface of the globe; and we must think of the two hundred existing species of quadrupeds as reduced to thirty-eight families. And though this is not at all the state of nature as we now find it, but a state much more ancient, at which we can arrive only by induction and by analogies...difficult to lay hold of, we shall attempt nevertheless to ascend to these first ages of nature by the aid of the facts and monuments which yet remain to us.\textsuperscript{30}

Here, clearly, is an evolutionary program, strictly limited by the assumption that there are irreducible ultimate species, yet tolerably ambitious: to regard all known kinds of quadrupeds as derived from thirty-eight original types, by modification in the course of natural descent; and to determine the general causes and conditions of the production of species in the ordinary sense, i.e., of relatively stable varieties. These ideas occurred to Buffon too late to be made use of in his general plan for the classification of the quadrupeds; that plan, it will be remembered, was formed while he was unluckily under the influence of the principle of continuity. But in the volumes on birds, of which the first

\textsuperscript{30} Vol. XIV., 1766, p. 358.
appeared in 1770, he had the opportunity for a fresh start; and he took advantage of it to introduce a method of distinguishing and classifying species which—within the limits already indicated—is expressly evolutionary in its principles.

For the natural history of the birds I have thought that I ought to form a plan different from that which I followed in the case of the quadrupeds. Instead of treating of the birds...by distinct and separate species, I shall bring several of them together under a single genus. Except for the domesticated birds, all the others will be reunited with the species nearest to them and presented together as being approximately of the same nature and the same family....When I speak of the number of lines of parentage, I mean the number of species so closely resembling one another that they may be regarded as collateral branches of a single stock, or of stocks so close to one another that they may be supposed to have a common ancestry and to have issued from that same original stock with which they are connected by so many points of resemblance common to them all. And these related species have probably been separated from one another only through the influences of climate and food, and by the lapse of time, which brings about all possible combinations and gives play to all the agencies that make for variation, for improvement, for alteration and for degeneration.31

Even the groupings which he gives, Buffon adds, can not be regarded, in the existing state of knowledge, as correctly and exclusively enumerating all the apparent species which are really akin to one another. The number of separate species which he lists, he intimates, is probably much too great. But at all events, he concludes with pride, his work is the first real attempt at an ornithologie historique.

The purpose of the present inquiry does not call for any extended exposition of Buffon’s views about the causes of modification in animals and the ways in which quasi-species are formed. In the essay "De la

dépéénération des animaux" the subject is discussed at the length of over sixty quarto pages; the theories there advanced have been sufficiently accurately summarized by many previous writers. In brief, the factors in modification which he mentions as the most important are changes of climate (in which the most potent influence is temperature), changes of food, and the effects of domestication. But it is evident that he also believed in a general tendency to variation in the germ, and in the influence of acquired habits, of the use and disuse of parts, and of acquired lesions and mutilations. Thus he explains the humps and the callosities on the knees and chest of the camel and the llama as due to the habits of those animals under domestication. Similarly, the callosities on the haunches of the baboons arise from the fact that "the ordinary position of these animals is a sitting one—so that the hard skin under the haunches has even become inseparable from the bone against which it is continually pressed by the weight of the body." These theories, of course, take for granted the inheritance of acquired characters, which Buffon also (less cautious here than Maupertuis32) explicitly asserts. It is, I suppose, also well known that Buffon called attention (as Linnaeus did independently) to the struggle for existence between species, due to the excessive multiplication of individuals, and pointed out how an equilibrium comes to be established (so long as external conditions remain constant) by means of this opposition.

It may be said that the movement of nature turns upon two immovable pivots—one, the boundless fecundity which she has given to all species; the other, the innumerable difficulties which reduce the results of that fecundity,

and leave throughout time nearly the same number of individuals in every species. 33

Buffon, in fact, rather over-worked this notion of a stable equilibrium, which rested upon the assumption of an approximate equality among species in their endowment for the struggle for survival. This is perhaps one reason why it did not occur to him to think of that struggle as causing a process of natural selection, or to see in it a factor in the formation of so-called species.

4. It must be evident to the reader from all that precedes that Buffon's mind, throughout nearly the whole of his life, was played upon by two opposing forces. Quite apart from any illegitimate and external influences, such as fear of the ecclesiastics—of which too much has been made—his thought was affected by two conflicting sets of considerations of a factual and logical sort. He saw certain definite reasons for regarding species as the fundamental constants of organic nature; what those reasons were has been sufficiently indicated. But he also saw that there was some force in the argument from the homologies; and—what in his case was still more important—he was committed to the program of explaining the diversities of organisms, so far as might be, by the hypothesis of modification in the course of descent; he was deeply impressed by the fact of variability; and he held to a theory of heredity (namely, of the heritability of acquired characters) which acted as a sort of powerful undertow towards a generalized evolutionism. Add to this that he was little careful of consistency and extremely careful of rhetorical effect—and it is not surprising that he occasionally forgot one side of his doctrine in emphasizing the other. There is one and, so far as I can

discover, only one passage in which he seems categorically to contradict his ordinary teaching of the impossibility of the descent of really distinct species, sterile *inter se*, from common ancestors. This occurs at the end of the chapter on "Animals Common to Both Continents" (Vol. IX., 1761).

It is not impossible that, without any deviation from the ordinary course of nature, all the animals of the New World may be at bottom the same as those of the Old—having originated from the latter in some former age. One might say that, having subsequently become separated by vast oceans and impassable lands, they have gradually been affected by a climate which has itself been so modified as to become a new one through the operation of the same causes which dissociated the individuals of the two continents from one another. Thus in the course of time the animals of America have grown smaller and departed from their original characters. This, however, should not prevent our regarding them today as different species. Whether the difference be caused by time, climate and soil, or be as old as the creation, it is none the less real. Nature, I maintain, is in a state of continual flux and movement. It is enough for man if he can grasp her as she now is, and cast but a glance or two upon the past and future, to endeavor to perceive what she may once have been and what she may yet become.

Here Buffon seems either to have forgotten or to have deliberately discarded his own usual criterion of diversity of species. He does not propose to inquire whether the American species are capable of having fertile progeny when mated with their respective congeners in the old world, but predicates difference of species solely on the ground of dissimilarity of form; and to the distinct species so determined he attributes an identical origin. But it is possible that he has here merely lapsed (as he apparently does occasionally elsewhere) into the terminology in which he was brought up, and is using the word "species" in the Linnaean sense rather than in his own.
More significant, perhaps, than this possibly inadvertent inconsistency is the fact that, in his fourteenth volume\textsuperscript{34} (1766), Buffon seems to raise explicitly the question—though only as a question—whether, after all, descent with modification may not extend to species as well as varieties.

After surveying the varieties which indicate to us the alterations that each species has undergone, there arises a larger and more important question, namely, how far species themselves can change—how far there has been a more ancient modification, immemorial from all antiquity, which has taken place in every family, or, if the term be preferred, in all the genera in which species that closely resemble one another are to be found. There are only a few isolated species which are like man in forming at once a species and a whole genus. Such are the elephant, rhinoceros, hippopotamus and giraffe, which constitute genera, or simple species, and descend in a single line, with no collateral branches. But all other races have the appearance of forming families, in which we may perceive a common source or stock from which the different branches seem to have sprung.\textsuperscript{35}

Even here one can not be wholly sure that Buffon is not referring to Linnaean species, and using the word "genera" to indicate what he usually means by species in the strict sense. Assuming, however, that he is speaking of "true" species, it must be observed that while he raises the question of their mutability, he does not answer it finally in the affirmative. For the passage is shortly followed by that cited earlier in this paper, in which Buffon, though he derives many species traditionally regarded as distinct from a common stock, yet finds even in "the first ages of nature" thirty-eight irreducible diversities of specific type among quadrupeds.

\textsuperscript{34} Just a year earlier we have found Buffon using the most exaggerated language possible about the changelessness of species.

\textsuperscript{35} Vol. XIV., p. 335; italics mine.
There is, however, one peculiarly interesting essay in which Buffon shows himself a little dubious even about that "most fixed point in nature" upon which his usual doctrine of the reality and constancy of species was based—namely, the fact of the sterility of hybrids. As I have already mentioned, this seemed to him so central a point in natural history that he for many years assiduously collected data concerning it, and caused experiments bearing thereon to be made and carefully recorded at his own estate at Montbard. The results of these inquiries, which he reports in the chapter "On Mules" (in the third supplementary volume, 1776), led him to the conclusion that hybrids are not necessarily without hope of posterity. On the testimony of an affidavit from a gentleman in San Domingo, Buffon declares that in hot climates mules have been known to beget offspring of mares, and females of their kind to breed with horses. "One was therefore wrong formerly in maintaining that mules are absolutely infertile." Other experiments in the crossing of goats and sheep, dogs and wolves, canaries and Goldfinches, are recited; they all go to show that sterility is merely a question of degree.

All hybrids (mules), says prejudice, are vitiated animals which can not produce offspring. No animal, say reason and experience, is absolutely infertile, even though its parents were of separate species. On the contrary, all are capable of reproduction, and the only difference is a difference of more or less.36

That hybrids are relatively infertile, and probably incapable of breeding with one another, Buffon still maintains; "their infecundity, without being absolute, may still be regarded as a positive fact." Something, therefore, is still left of his test of unity of species. But now

36. Supp., III., p. 20; the italics are Buffon's.
that it seemed to be reduced to a mere difference in degree, it was no longer the sharp-cut, decisive, impressive thing that it had at first appeared. And, feeling that his criterion of species had a good deal weakened, Buffon was led—not, indeed, even now to an altogether unequivocal affirmation of the descent of real species from one another—but to a confused, half-agnostic utterance, in which he seems to take at least the possibility of such descent for granted:

In general, the kinship of species is one of those profound mysteries of nature which man will be able to fathom only by means of long and repeated and difficult experiments. How, save by a thousand attempts at the cross-breeding of animals of different species, can we ever determine their degree of kinship? Is the ass nearer to the horse than to the Zebra? Is the dog nearer to the wolf than to the fox or the jackal? At what distance from man shall we place the great apes, which resemble him so perfectly in bodily conformation? Were all the species of animals formerly what they are today? Has their number not increased, or rather, diminished (sig)?...What relations can we establish between this kinship of species and that better known kinship of races within the same species? Do not races in general arise, like mixed species, from an incapacity in the individuals from which the race originated for mating with the pure species? There is perhaps to be found in the dog species some race so rare that it is more difficult to breed than is the mixed species produced by the ass and the mare. How many other questions there are to ask upon this matter alone—and how few of them there are that we can answer! How many more facts we shall need to know before we can pronounce—or even conjecture—upon these points! How many experiments must be undertaken in order to discover these facts, to spy them out, or even to anticipate them by well-grounded conjectures!37

This passage certainly indicates a strong inclination towards an acceptance of a thorough-going doctrine of descent; yet in Butler's lengthy compilation of the evidences of Buffon's evolutionism it is not cited at all! The volume containing it, says Butler, offers "little

which throws additional light upon Buffon's opinion concerning the mutability of species." In truth, it offers one of the best of the extremely few passages which give some plausibility at least to the theory that Buffon was continuously working towards an unqualified transformism and actually arrived at that position in his later life. But if he reached it (which his language just quoted does not quite justify us in declaring) he did so only in a transient mood. For, as we have already seen, in 1779, in the "Époques de la Nature," we once more find him asserting—though no longer upon the ground of the sterility of hybrids—that the "constitutive form" of each separate species is the same today as in "the earliest ages."

5. It is more important, and it is commonly easier, to determine what opinions a man's writings tended to encourage than to determine what opinions he actually held. Mind-reading is perhaps no essential part of the history of science. If, then, in conclusion, we raise the more important question with respect to Buffon, it is evident that his work both fostered and hindered the propagation of evolutionary ideas in biology. Earlier than any other except Maupertuis, he put the hypothesis of organic evolution before his contemporaries in a clear and definite form. He called to their attention, also, the facts of comparative anatomy which constitute one of the principal evidences for that hypothesis. Throughout the rest of the century we never cease to hear about the wonderful "unity of type" characteristic of the vertebrates and perhaps of all living things. It was this consideration which led Kant as near to evolutionism as he ever came; Herder and Goethe are full of it, though the former never admitted its full evolutionary consequences; and all, it is evident, learned

38. Evolution Old and New, p. 165.
it directly from Buffon. He, says Goethe, was the first to recognize

_eine ursprüngliche und allgemeine Vorzeihung der Tiere_. Buffon, more-

ever, once and for all inscribed upon the program of natural history,
as its primary problems, the reduction of the number of separate species
to a minimum, the derivation of highly divergent forms from a common
origin through natural descent, and the discovery of the causes and
methods of modification. He, finally, did more than any one else to
habituate the mind of his time to a vastly (though not yet sufficiently)

enlarged time-scale in connection with the history of organic nature, a
necessary prerequisite to the establishment of transformism.

These were great steps in the progress of evolutionism. But it

is equally true that Buffon probably did more than any other eighteenth-
century writer to check the progress of evolutionism. He did so partly
by the authority which, for his contemporaries, attached to those per-
sonal utterances of his favorable to the doctrine of immutability. These
utterances were far more numerous and more categorical than those which
could be quoted on the other side; and they certainly were not taken as
ironical by the average reader of the period. But, what is still more
important, Buffon put into currency what passed for a scientific and serious
argument against any wholesale theory of descent. In the eyes of many
learned men of his own and later generations, perhaps his chief single
contribution to science was his definition of species. This, as we
shall see, was regarded as of immense importance by Kant, and was, indeed,
the starting point and the controlling principle of that philosopher's
biological speculations. "It is Buffon," wrote Flourens as late as 1844,
"who has given us the positive character of a species." Now before the
Buffonian criterion of species was propounded, there already existed a
tendency towards evolutionism, fostered by the principle of continuity and by such embryological conceptions as those of Maupertuis—a tendency to disregard species altogether and to infer from the variability of individuals to an unlimited and rather promiscuous mutability of the successive generations of living things. If it had not been for Buffon, transformism would probably have developed at first through the increase and diffusion of this tendency; and its development might well, in that case, have been more rapid. But when species came to be regarded as real "entities of nature," determined by the objective criterion of the sterility of hybrids, this somewhat too facile evolutionism received a check, and a certain presumption of the constancy of true species seemed to be created. This presumption had all the more force because it left room for a large measure of mutability in the case of varieties, and thus gave a sort of appeasement to the strong impulse towards genetic modes of thought which was already active in the mid-eighteenth century. But more than all this, Buffon, as we have seen, from the first managed to associate with his definition of species the assumption that the sterility of one kind of animal when crossed with another was a character that (unlike almost all others) could not have been produced in the course of descent with modification. And this supposition that the sterility of hybrids was incapable of an evolutionary explanation long remained a serious obstacle to the acceptance of the theory of descent, even with those little influenced by theological prejudices against the theory. We find even Huxley in 1862 troubled over the difficulty. In his Edinburgh lectures of that year "he warned his hearers of the one missing link in the chain of evidence—the fact that selective breeding has not yet produced species sterile to one another." The doctrine of descent
was merely to be "adopted as a working hypothesis,...subject to the
production of proof that physiological species may be produced by
selective breeding." Since Buffon appears to have been the first
to emphasize the notion of physiological species, and to give cur-
rency to the supposition that the sterility of hybrids affords a pre-
sumption against any thorough-going transformism, he must be regarded
as having done more than almost any man of his time to counteract the
tendency which he also, perhaps, did more than any other to promote.