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BUFFON, ORGANIC CHANGE, AND THE RACES OF MAN

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PREFACE

Buffon's massive thirty-six volumes of the Histoire naturelle, générale et particulière (Paris: l'Imprimerie Royale, 1749-1789) has four large divisions: Histoire naturelle, générale et particulière, avec la description du cabinet du Roi (15 volumes, 1749-1767), Histoire naturelle des oiseaux (9 volumes, 1770-1783), Supplément à l'Histoire naturelle (7 volumes, 1774-1789), and the Histoire naturelle des minéraux (5 volumes 1783-1788). In this dissertation, references to the work will be cited by the title of the division, the division volume number, and the page number. Abbreviations for the different divisions of the Histoire naturelle are as follows:

HN Histoire naturelle, générale et particulière, avec la description du cabinet du Roi;

HNO Histoire naturelle des oiseaux;

HNS Supplément à l'Histoire naturelle; and

HNM Histoire naturelle des minéraux.

All citations are taken from the Sir Harold Hartley and Duane H. D. Roller eds., Landmarks of Science (New York: Readex Microprint, 1969) microform reproduction of the original Histoire naturelle.

For the most readily available source of many of Buffon's better known writings, one should consult the Oeuvres philosophiques de Buffon edited by Jean Piveteau (1954), which will be cited as O.P.

The titles of the Histoire and the Mémoires of the Académie Royale des Sciences and the Philosophical Transactions of the Royal Society of London varied somewhat during the period this dissertation covers. In footnotes, these works will be referred to as Histoire de l'Académie Royale des Sciences, Mémoires de l'Académie Royale des Sciences, and Philosophical Transactions, respectively. Full and accurate titles for each item will be given in the bibliography.

Many people at The University of Oklahoma have aided in the completion of this dissertation. I wish to acknowledge my indebtedness to Dr. Kenneth L. Taylor, the director of this dissertation. He never failed to give me encouragement, advice, and just the right kind of criticism. I would like to thank the other members of my committee: Dr. Thomas M. Smith, Dr. Sabetai Unguru, Dr. David B. Kitts, and Dr. David H. Miller.

To my wife, Julie, I owe an especial thanks. Without her understanding, devotion, and love nothing would have been accomplished. Our son, Mark, has done without a full time father for much too long a time. I thank him for his patience.

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BUFFON, ORGANIC CHANGE, AND THE RACES OF MAN

CHAPTER I

INTRODUCTION: BUFFON AS PRECURSOR

Several modern commentators upon Buffon's works have concluded, without much apparent hesitation, that Buffon believed in the mutability of species and thus must have been a forerunner of modern conceptions of evolution. Charles Singer stated that Buffon was one of the few eighteenth-century naturalists to break away from a static view of the world of life and was the "first to give both form and substance to a conception of evolution of living things . . . ."[1] And, although he expressed himself variously, Singer continued, as "regards the fixity of species . . . he settled gradually into opposition to that view."[2] Conway Zirkle, in an article entitled "Natural Selection before the 'Origin of Species,'" declared that "Buffon's contribution to the theory of evolution is well known, for

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[1]Charles Singer, A Short History of Scientific Ideas to 1900 (Oxford: At the Clarendon Press, 1959), p. 503.

[2]Ibid., p. 504.

he was undoubtedly the most famous evolutionist of his day."[3] Philip G. Fothergill asserted that Buffon was "the first naturalist to visualise the conception of evolution in a more or less concrete form."[4] Furthermore, Fothergill continued, "some modern writers place him along with Lamarck as the co-founder of the causal theory of evolution called 'Lamarckism.'"[5] He was, Fothergill concluded, a man in "many respects . . . in advance of his times, . . ."[6] Loren Eiseley, in Darwin's Century, has written that "Buffon's 'degeneration' is nothing more than a rough sketch of evolution."[7] Anthony Leeds wrote in an article published in 1974 "that virtually all the elements involved in Darwin's model of evolutionary process had been thought of before him, especially by Georges Buffon, . . ."[8]

The idea that Buffon maintained a belief in something like a modern theory of evolution goes back to the second half of the nineteenth century. Samuel Butler (1835-1902), in an apparent attempt

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[3]Conway Zirkle, "Natural Selection before the 'Origin of Species,'" Proceedings of the American Philosophical Society 84 (1941): 89.

[4]Philip G. Fothergill, Historical Aspects of Organic Evolution (New York: Philosophical Library, 1953), pp. 47-48.

[5]Ibid., p. 48.

[6]Ibid., p. 49.

[7]Loren Eiseley, Darwin's Century: Evolution and the Men Who Discovered It. (Garden City, New York: Doubleday & Company, Inc., 1958), p. 39. (Hereinafter referred to as Darwin's Century.)

[8]Anthony Leeds, "Darwinian and 'Darwinian' Evolutionism in the Study of Society and Culture," in The Comparative Reception of Darwinism, ed. Thomas F. Glick (Austin and London: University of Texas Press, 1974), pp. 440-41.

to discredit the originality of Darwin's theory,[9] took an extreme position in favor of Buffon as an evolutionist. Butler stated that Buffon never equivocated in his belief in the transmutation of the species throughout the Histoire naturelle. In a book called Evolution Old and New (1879), Butler, as Arthur O. Lovejoy put it, claimed that "all the anti-evolutionary passages in the Histoire Naturelle are ironical."[10] Buffon, as Butler saw it, "scattered his theory in fragments up and down his works . . . ."[11] He put in the appropriate number of statements affirming the immutability of species in order to appease the Sorbonne, while at the same time leading the discerning reader "irresistibly in the right direction, . . ."[12]

Twenty years after Butler's work appeared, Edward Clodd (1840-1930) made an argument remarkably like Butler's:

> His opinions, clashing as they did with orthodox creeds, were given in a tentative, questioning fashion, so that where ecclesiastical censure fell, retreat was easier. As has been seen in his submission to the Sorbonne, he was not of the stuff of which martyrs are made. Perhaps he felt that the ultimate victory of

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[9]Peter J. Bowler, "Evolutionism in the Enlightenment," History of Science 12 (1974): 171.

[10]Arthur O. Lovejoy, "Buffon and the Problem of Species," Popular Scientific Monthly 79 (1911): 465. For a revised version of this same article see "Buffon and the Problem of Species," in Forerunners of Darwin: 1745-1859, eds. Bentley Glass et al. (Baltimore: The Johns Hopkins Press, 1959).

[11]Samuel Butler, Evolution, Old and New; or, the Theories of Buffon, Dr. Erasmus Darwin, and Lamarck, as Compared with that of Mr. Charles Darwin (London: Hardwicke and Bogue, 1879), p. 84. (Hereinafter referred to as Evolution, Old and New.)

[12]Ibid., p. 83.

> his opinions was sufficiently assured to make self-sacrifice needless. But, under cover of pretence at inquiry, his convictions are clear enough. He was no believer in the permanent stability of species, . . . But he writes with an eye on the Sorbonne when, hinting at a possible common ancestor of horse and ass, and ape and man, he slyly adds that since the Bible teaches the contrary, the thing cannot be. Thus he attacked covertly; by adit, not by direct assault; and to those who read between the lines there was given a key wherewith to unlock the door to the solution of many biological problems.[13]

But the idea that Buffon harbored anything like a nineteenth-century theory of evolution is mistaken. Buffon, like many eighteenth-century naturalists, thought that organic change among species could be explained naturally, but he did not anticipate any later theories of evolution. His theory of organic variation was in fact closer to a theory of devolution than to any modern theory of evolution, Lamarckian, Darwinian, or otherwise. Buffon almost always spoke of altered organisms as having degenerated from the pristine forms (which did not evolve but were formed spontaneously) of their kind. These degenerated organisms have, in a very real sense, become inferior forms of life. That is to say, degenerate specimens are often smaller, less well formed, and in general less lively than their less altered kin.

It is unfortunate that Buffon's thoughts are still linked to nineteenth- and twentieth-century concepts of evolution, for it obscures our understanding of his real role in the subsequent development of biological thinking. There is little excuse for the continued repetition of at least the more obviously erroneous claims about

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[13]Edward Clodd, Pioneers of Evolution from Thales to Huxley (New York: D. Appleton and Company, 1897), pp. 109-11.

Buffon's precursorship in evolutionary thinking. As early as 1911 Arthur O. Lovejoy, in a general attack on all of those who viewed Buffon as a full-fledged evolutionist but in particular on Butler, argued that throughout the Histoire naturelle Buffon attempted to place severe restrictions on the degree to which species could alter. There are, Lovejoy admitted, statements made by Buffon which seem to indicate that he believed in an evolutionary thesis. However, Lovejoy shows, statements which argue for the relative stability of living things are "far more numerous and more categorical than those which could be quoted on the other side; . . ."[14] For example, Lovejoy pointed out, in the article on the ass, Buffon used several much more cogent arguments than the religious one -- the only one cited by Butler and Clodd to show that Buffon's anti-evolutionary stance was a mere ruse to hide his true belief in the evolution of organisms -- to counter his suggestions that degeneration leads to new species.[15]

In quite recent years several works have appeared which, in the main, seem to confirm Lovejoy's basic contention that Buffon's science did not harbor full-blown, nineteenth-century notions of evolution. The most important of these is Jacques Roger's masterful Les sciences de la vie dans la pensée française du XVIII^{e} siècle.[16]

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[14]Lovejoy, "Buffon and the Problem of Species" (1911), p. 566; (1959), p. 112.

[15]Ibid. (1911), pp. 554-67; (1959), pp. 96-100.

[16]Jacques Roger, Les sciences de la vie dans la pensée française du XVIII^{e} siècle: La génération des animaux de Descartes à l'Encyclopédie (Paris: Armand Colin, 1963), pp. 527-84. (Hereinafter referred to as Les sciences de la vie.)

Paul L. Farber,[17] J.S. Wilkie,[18] Peter J. Bowler,[19] Robert Wohl,[20] and Phillip R. Sloan[21] have all done their part in placing Buffon's theory of organic alteration in its own time.

While Buffon has been viewed as one of the founders of evolution by some scholars, he has been seen as one of the founders of modern anthropology by others. In 1847 Pierre Flourens (1794-1867), a physiologist and a commentator on Buffon's works, stated that "Anthropology sprung [sic] from a great thought of Buffon. Up to his time man had never been studied, except as an individual; Buffon was the first who, in man, studied the species."[22] This same sentiment was more recently expressed by Jean Piveteau. Piveteau stated: "On peut voir en Buffon l'un des fondateurs de l'anthropologie, c'est-à-dire de l'étude de l'homme comme espèce et non comme

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[17]Paul L. Farber, "Buffon and the Concept of Species," Journal of the History of Biology 5 (1972): 259-84.

[18]J.S. Wilkie, "The Idea of Evolution in the Writings of Buffon," Annals of Science 12 (1956): 48-62, 212-27, and 255-66. (Hereinafter referred to as "The Idea of Evolution.")

[19]Peter J. Bowler, "Bonnet and Buffon: Theories of Generation and the Problem of Species," Journal of the History of Biology 6 (1973): 259-81 (Hereinafter referred to as "Bonnet and Buffon") and "Evolutionism in the Enlightenment," pp. 159-83.

[20]Robert Wohl, "Buffon and His Project for a New Science," Isis 51 (1960): 186-99.

[21]Phillip R. Sloan, "The Idea of Racial Degeneracy in Buffon's Histoire Naturelle," in Racism in the Eighteenth Century, ed. Harold E. Pagliaro, Studies in Eighteenth-Century Culture, vol. 3 (Cleveland and London: The Press of Case Western Reserve University, 1973), pp. 293-321.

[22][Pierre] Flourens, "Memoir of Blumenbach," in The Anthropological Treatises of Johann Friedrich Blumenbach, trans. and ed. Thomas Bendyshe (London: Longman, et al., 1865), p. 55.

individu."[23] And a modern anthropologist, Walter Scheidt, stated that Buffon "can frankly be called the 'first anthropologist'; . . ."[24]

To imply that Buffon was the first anthropologist or a founder of modern anthropology is to take the risk of confusing his interests in man with those of a later time and of misconstruing the issues, the problems, and the difficulties that were germane to Buffon's theory of human racial formation. There is no need to take that risk, however. It is more accurate simply to state that Buffon was the first naturalist who conceived of an autonomous science of man and who considered the human species as a product of the laws of nature.

There are very few works which deal at length with Buffon's explanation of human racial formation. Those which do usually only consider what he had to say in one of his early essays, the "Variétés dans l'espèce humaine" (1749). In this essay, Buffon presented the not uncommon notion that environmental factors, primarily the climate, food, and mode of living, have caused variations upon the white prototype man. Nowhere in the "Variétés" did Buffon discuss human alteration in terms of his concept of species or within the context of the theory he used to explain the existence and continuity of living forms. Slowly, essay after essay, throughout the many years

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[23]Jean Piveteau, "Introduction à l'oeuvre philosophique de Buffon," in O.P., p. xxiv. "We can see in Buffon one of the founders of anthropology, that is to say, of the study of man as a species and not as an individual." (Hereinafter referred to as "Introduction.") Unless otherwise indicated, all translations are mine.

[24]Walter Scheidt, "The Concept of Race in Anthropology and the Division into Human Races from Linnaeus to Deniker," in This is Race, ed. Earl W. Count (New York: Henry Schuman, 1950), p. 360.

that the Histoire naturelle took shape, Buffon developed an explanation of the human races which linked it not only to his science of living things and concept of species but to his cosmology, geology, and his history of human progress. To consider only what Buffon had to say in the "Variétés," then, is to fail to appreciate how the human races fit into Buffon's grand scheme of things.

Furthermore, if one reads beyond the "Variétés" and considers all the places in the Histoire naturelle which pertain to the degeneration of and the distinctions between the races one is unlikely to write anything like the following:

> Buffon's views on racial differences are also singularly enlightened. Persuaded that the ability to interbreed established the unity of the human species beyond all question, and that the observable differences among men were merely the direct effects of differences in climate, food, and manner of life, he regarded the conventional lines of demarcation among human types as essentially arbitrary: . . . .[25]

Buffon believed that all nonwhite peoples were inferior to white peoples, but he came to believe that Negroes and American Indians in particular were very much inferior to white Europeans. His views on racial differences were not, then, singularly enlightened, if by singularly enlightened one means that the distinctions among races are relatively unimportant and that the human races are comparable in natural ability and worth. Buffon's feelings toward nonwhite, non-European peoples were just as racist as those of most other naturalists concerned with the racial diversity of mankind in the eighteenth century.

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[25]Otis E. Fellows and Stephen F. Milliken, Buffon (New York: Twayne Publishers, Inc., 1972), p. 140.

The two primary objectives of this work are to discuss Buffon's explanation of organic alteration and formation of the human races (1) within the context of the theoretical structure he created to explain living nature and (2) in light of the issues surrounding eighteenth-century theories of racial formation. The second chapter is a short biographical sketch. The third chapter is a discussion, in light of the epistemological problems confronting eighteenth-century naturalists, of Buffon's philosophy of nature. The fourth chapter is concerned with Buffon's theory of generation (reproduction) and his concept of species. Then, in light of his theory of generation and his concept of species, attention is directed toward his explanation of organic alteration within species. The next chapter is devoted to organic alteration within the human species. The seventh chapter contains speculations regarding the significance of Buffon's theory of race. The final chapter is a summary.

CHAPTER II

BIOGRAPHICAL SKETCH

Georges-Louis Leclerc, the future comte de Buffon, was born at Montbard in Burgundy on the seventh day of September 1707.[1] His father, Benjamin-François Leclerc (1683-1775) was a minor civil servant, the administrator of the salt tax, in Montbard.[2] In 1717 Benjamin-François, with money his wife had inherited from a wealthy uncle, was able to move his family into the privileged noble class. He purchased the terre de Buffon, became seigneur of Montbard, and purchased the post of conseiller in the Parlement de Bourgogne in Dijon, the provincial capital.[3]

From 1717 to 1723 Buffon studied at the Collège des Jésuites in Dijon. He in no manner distinguished himself as a student, although he did show a predilection for mathematics. From 1723 to 1726, probably at the urging of his father, Buffon studied law at

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[1]Piveteau, "Introduction," p. VII.

[2]Fellows and Milliken, Buffon, p. 40.

[3]Farber, "Buffon's Concept of Species" (Ph.D. dissertation, Indiana University, 1970), p. 10.

Dijon.[4] But perhaps of more significance, Buffon became active in a circle of savants led by Jean Bouhier (1673-1746), a leading humanist of the period.[5]

In 1728, after he had obtained his law degree, Buffon left Dijon for the university city of Angers, where he may have studied medicine, botany, mathematics,[6] and, some suggest, led a life of youthful extravagance.[7] At any rate, during his stay in Angers, Buffon seems to have read the Traitez de l'eqvilibre des liqvevrs, et de la pesantevr de la masse de l'air by Blaise Pascal (1623-1662) and the third English edition of Newton's Principia (1726). More than likely he also read the Elémens de la géometrie de l'infini (1727) by Bernard le Bovier de Fontenelle (1657-1757) and perhaps Traité de la connaissance des animaux (1642) by Marin Cureau de La Chambre (1596-1669).[8]

Legend has it that a duel forced Buffon to leave Angers in October 1730. Why he left Angers, however, is still a matter of conjecture. For whatever reason, he left Angers and began a tour of

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[4]Dictionary of Scientific Biography, s.v. "Buffon, Georges-Louis Leclerc, comte de." by Jacques Roger, 2: 576a. (Hereinafter reffered to as "Buffon.")

[5]Farber, "Buffon's Concept of Species," p. 11.

[6]Roger, "Buffon," p. 576a.

[7]Farber, "Buffon's Concept of Species," pp. 11-12.

[8]Lesley Hanks, Buffon avant l'"Histoire naturelle," (Paris: Presses universitaires de France, 1966), p. 19.

Southern France and Italy.[9] Departing on 3 November 1730,[10] he was in Nantes by 5 November 1730.[11] His travelling companions were Evelyn Pierrepont (1711-1773), the second Duke of Kingston, and the Duke's tutor Nathaniel Hickman (1695-?), a physician, a naturalist interested in insects, and Fellow of the Royal Society.[12] In the first half of their trip, they travelled to Nantes, La Rochelle, Rochefort, Bordeaux, Montauban, Toulouse, Carcassonne, Narbonne, Béziers, Montpellier, and Lyon. Family affairs brought Buffon back to Dijon in the summer of 1731. What these affairs were is unknown, but they could have involved the death of his brother (22 January 1731) or his mother's illness (she died 1 August 1731). By October 1731 Buffon had resumed his travels. During the second phase of their trip, Buffon and his fellow travellers visited Geneva and the Italian cities of Turin, Genoa, Milan, Florence, and Rome.[13]

With the exception of suffering from a fever, which had become a "vrai Protée . . . , [which] m'attaque sous mille formes

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[9]Roger, "Buffon," p. 576b.

[10]Hanks, Buffon avant l'"Histoire naturelle," p. 22.

[11][Georges-Louis Leclerc, comte] de Buffon to Richard de Ruffy, 5 November 1730, in H. Nadault de Buffon, ed., Buffon: Correspondance générale, 2 vols. (Paris, 1885; reprint ed., Genève: Slatkine Reprints, 1971), 1: 5. (Hereinafter referred to as Correspondance.)

[12]For information regarding King and Hickman see Stephen F. Milliken, "Buffon and the British," (Ph.D. dissertation, Columbia University, 1965), pp. 54-78.

[13]Hanks, Buffon avant l'"Histoire naturelle," pp. 22-23.

différentes, . . . ,"[14] during his stays at Nantes and Bordeaux in the winter of 1731, Buffon enjoyed much of his time as a tourist. On 20 January 1732 Buffon wrote to Gilles-Germain Richard de Ruffy (1706-1794), a classmate at Dijon and a lifelong friend, this lively account of the pleasures of Rome:

> Rome est à cette heure dans son brillant; le carnaval est commencé depuis quinze jours; quatre opéras magnifiques et autant de comédies, sans compter plusieurs petits théâtres, y font les plaisirs ordinaires et je vous avoue qu'ils sont extraordinaires pour moi par l'excellence de la musique et le ridicule des danses, par la magnificence des décorations et la métamorphose des eunuques qui y jouent tous les rôles des femmes; . . .[15]

Still, Buffon made time to learn some Italian, practice his English, and carry on a correspondence concerning mathematics with Gabriel Cramer (1704-1752).[16]

Upon his return to Dijon in January of 1733, Buffon, contrary to his father's wishes, immediately demanded his share of his mother's fortune. He not only acquired a sum of 80,000 livres, he also obtained the house and lands at Montbard.[17] During this same period he began to move among the scientific circles in Paris, perhaps frequented the

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[14]Buffon to Richard de Ruffy, 22 January 1731, Correspondance, 1: 7. "veritable Proteus . . . , [which] attacks me under a thousand different forms, . . ."

[15]Buffon to Richard de Ruffy, 20 January 1732, Correspondance, 1: 12. "Rome is at this hour in its brillance. The carnival started a fortnight ago. Four magnificent operas and as many comedies, without counting several small theaters, are ordinary pleasures here, and I admit that for me they are extraordinary, by the excellence of the music, the ridiculous dances, the magnificent stage designs, and the metamorphosis of the eunuchs who play all the women's roles; . . ."

[16]Hanks, Buffon avant l'"Histoire naturelle," p. 23.

[17]Fellows and Milliken, Buffon, pp. 46-47.

salons, and won favor with the powerful minister of the Navy, Jean-Frédéric Phélypeaux de Maurepas (1701-1781).[18]

Buffon's "Mémoire sur le jeu du franc-carreau,"[19] his work on the strength of timber -- which was undertaken at the request of Maurepas, who was seeking to improve the Navy's war vessels by developing a better quality of wood for their construction -- and the patronage of Maurepas and Louis-Henri duc de Bourbon (1692-1740)[20] were all instrumental in Buffon being elected in 1734 as a membre adjoint in the mechanical section of the Académie Royale des Sciences. At once he allied himself with the Newtonians in their battle against the Cartesians.[21]

In 1734 Buffon began his practice of spending winters in Paris and the spring and summer months at Montbard.[22] While intellectual affairs occupied much of his attention, Buffon also managed his estate and undertook several commercial ventures. For example, he established an iron foundry -- which apparently was quite successful -- in the village of Buffon. Cannon for the army and the navy and iron fences for the Jardin du Roi were among the things manufactured there. Through hard work and a head for business, Buffon eventually became a very wealthy man, and at the height of his career

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[18]Hanks, Buffon avant l'"Histoire naturelle," pp. 35-42.

[19]Roger, "Buffon," p. 576b.

[20]Farber, "Buffon's Concept of Species," pp. 13-14.

[21]Ibid., p. 14.

[22]Hanks, Buffon avant L'"Histoire naturelle," pp. 65-57.

his annual income was 80,000 livres, a very considerable amount indeed.[23]

In addition to the management of his estate, attention to business affairs, work in silviculture, and his continued research on the strength of timber throughout the late 1730's and early 1740's,[24] Buffon somehow found the time and energy in 1734 to translate Vegetable Staticks (1727) by Stephen Hales (1679-1761). This translation assured Buffon of a reputation as an admirer of English experimental science and a notable young Newtonian.[25]

Reflecting his growing interests in natural history, Buffon switched from the mechanical section to the botanical section of the Académie des Sciences. On 18 March 1739 Buffon became adjoint botaniste at the Académie, replacing Bernard de Jussieu (1699-1777), who had been elevated to the rank of membre associé. Three months later Buffon, himself, was promoted an associé, replacing Jussieu again, who had become a pensionnaire.[26] Also in 1739 Buffon was elected to the Royal Society of London.[27]

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[23]Fellows and Milliken, Buffon, pp. 47-49.

[24]E. Genet-Varcin and Jacques Roger, "Bibliographie de Buffon," O.P., p. 521.

[25]Farber, "Buffon's Concept of Species," pp. 14-15.

[26]Piveteau, "Introduction," p. VII.

[27]Harcourt Brown, "Buffon and the Royal Society of London," in Studies and Essays in the History of Science and Learning offered in Homage to George Sarton, ed. M.F. Ashley Montagu (New York: Henry Schuman, 1946?), p. 155.

On 16 July 1739 Charles-François de Cisternay Dufay (1698-1739), the Intendant of the Jardin du Roi, died. Dufay had brought the Jardin from obscurity and neglect in 1732 to a scientific institution of some renown at the time of his death. For example, he had begun to establish contacts whose chief purpose was to provide the Jardin with plant and animal specimens. With the help of Maurepas and the academician Jean Hellot (1685-1766) and perhaps at the request of Dufay before his death,[28] on 26 July 1739, ten days after Dufay's death, Buffon was appointed the new Intendant of the Jardin du Roi.[29]

In spite of the time devoted to the administration of the Jardin, Buffon nonetheless continued his scientific work. He submitted several essays to the Académie bearing such diverse titles as "Mémoire sur la culture des forêts" (1742), "Dissertation sur les couleurs accidentelles" (1743), "Réflexions sur la loi d'attraction" (1745), "Invention des miroirs ardens, pour brûler à une grande distance" (1747), "Découverte de la liqueur séminale dans les femelles vivipares, et du resérvoir qui la contient" (1748), and "Nouvelle invention des miroirs ardens" (1748).[30]

His construction of burning mirrors that could ignite wood two hundred feet away made Buffon's name famous all over Europe. Buffon not only demonstrated that Archimedes could have defended Syracuse with such mirrors, he also proved that the great René

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[28]Fellows and Milliken, Buffon, pp. 54-55.

[29]Piveteau, "Introduction," p. VIII.

[30]Genet-Varcin and Roger, "Bibliographie de Buffon," O.P., p. 521.

Descartes (1596-1650) was wrong in his assertion that mirrors of that strength were theoretically impossible to construct. Spectators -- including King Louis XV (1710-1774) himself -- flocked to witness the marvel, and Frederick the Great of Prussia (1712-1786) sent Buffon his congratulations.[31]

Although not as widely known as his construction of burning mirrors, the preface to Buffon's translation of The Method of Fluxions and Infinite Series; with its Application to Geometry of Curve-Lines (from John Colson's English translation of 1736) by Isaac Newton (1642-1727) reveals an epistemological position that was reiterated throughout the Histoire naturelle. Buffon advocated that ideas should be derived from and correspond to existing objects and their operations. Infinity, for example, since it is only an idea derived from another idea and not from objective reality, has no existence. Furthermore, it is derived by a process of negation or privation. Buffon wrote:

> On ne doit donc considérer l'Infini soit en petit, soit en grand, que comme une privation, un retranchement à l'idée du fini, dont on peut se servir comme d'une supposition qui dans quelques cas peut aider à simiplifier les idées, & doit generaliser leurs résultats dans le pratique des Sciences; . . .[32]

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[31]Fellows and Milliken, Buffon, p. 57.

[32]Isaac Newton, La methode des Fluxions, et des suites infinies trans. by [Georges-Louis Leclerc, comte de Buffon] (Paris: Chez Debure l'aine, 1740), p. x. "We must therefore consider Infinity, either small or great, as a privation, an abridgment of the idea of finite, which as a supposition in a few cases can be used as an aid to simplify ideas and to generalize their results in the practice of Science; . . ."

Thus, "l'idée de l'infini n'est qu'une idée de privation, & n'a point d'objet réel."[33]

In 1749 the first three volumes of Buffon's most famous work, the Histoire naturelle, générale et particulière, were published. In these first volumes Buffon developed his philosophy of Nature, wrote a theory of the earth, advanced a new theory of generation (reproduction) based upon Newtonian principles, and presented a natural history of man. The renown of the author and the elevated, elegant, and yet clear prose of the work assured the Histoire world-wide popularity and fame. In addition it contained finely detailed engravings. And, it had the approval of the crown.

Four years after the publication of the first three volumes of the Histoire naturelle Buffon became a member of the French literary elite. In 1753 he was elected to the respected and exclusive Académie Française. In his acceptance "Discours" Buffon argued that a writer's style is dependent upon the order he gives his thought:

> Le style n'est que l'ordre & le mouvement qu'on met dans ses pensées. Si on les enchaîne étroitement, si on les serre; le style devient ferme, nerveux & concis; si on les laisse se succéder lentement, & ne se joindre qu'à la faveur des mots, quelqu'élégans qu'ils soient, le style sera diffus, lâche & traînant.[34]

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[33]Ibid., p. viii. "the idea of infinity is only an idea of privation and has no real object."

[34][Georges-Louis Leclerc, comte] de Buffon, "Discours prononcé a l'Académie Françoise par M. de Buffon, le jour de sa réception," O.P., p. 500b. "Style is only the order and movement he places in his thoughts. If he links them tightly -- if he condenses them -- the style becomes firm, virgorous, and concise; if he allows them to succeed one another slowly and to be united merely under a cover of words, however elegant they maybe, the style will be wordy, lax, and dawdling."

Style remained nothing less than an objective of first importance throughout Buffon's long career.

The volumes of the Histoire naturelle continued to appear over the years, and the publication of each new volume increased the fame and popularity of both the author and his work. Along with fame came honor and admiration. Academies the world over elected him as a member. Kings, queens, and prime ministers were counted among his correspondents. Naturalists, both amateur and professional, thought it an honor to be considered one of those mentioned in the Histoire. French colonial civil servants and explorers sent him both information and specimens. By the time of his death on 16 April 1788 Buffon was considered one of the "lamps" of the Enlightenment.[35]

Even a bitter adversary, Marie Jean Antoine Nicolas Caritat, marquis de Condorcet (1743-1794), stated that posterity would judge Buffon kindly:

> . . . il restera toujours dans la classe si peu nombreuse des philosophes dont une postérité reculée lit encore les ouvrages.
> . . . . . .
>
> L'histoire des sciences ne présente que deux hommes qui par la nature de leurs ouvrages paraissent se rapprocher de M. de Buffon, Aristote et Pline. Tous deux infatigables comme lui dans le travail, étonnants par l'immensité de leurs connaissances et par celle des plans qu'ils ont conçus et exécutés, tous deux respectés pendant leur vie et honorés après leur mort par leurs concitoyens, ont vu leur gloire survivre aux révolutions des opinions et des empires, aux nations qui les ont produits, et même aux langues qu'ils ont employées, et ils semblent par leur exemple promettre à M. de Buffon une gloire non moins durable.[36]

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[35]Farber, "Buffon's Concepts of Species," p. 1.

[36][Antoine-Nicolas Caritat, marquis de] Condorcet, "Éloge de Buffon," in Oeuvres complètes de Buffon, avec les descriptions anatomiques de Daubenton, son collaborateur, ed. M. [Jean Vincent Felix]

Lamouroux, vol. 1: Théorie de la terre (Paris: Chez Verdière et Ladrange, 1824), pp. LIII-LIV. ". . . he will always remain in that numerically small class of philosophers whose work a distant posterity still reads.

. . . . . .

The history of science presents only two men who by the nature of their works appear to come close to M. de Buffon -- Aristotle and Pliny. Both indefatigable workers like him -- amazing in the immensity of their knowledge and the plans that they have conceived and executed, both respected during their lives and honored after their deaths by their countrymen -- they have seen their glory survive the revolutions of opinions and of empires, survive the nations which have produced them and even the languages which they used, and they seem by their example to promise M. de Buffon a glory no less durable.

CHAPTER III

BUFFON'S PHILOSOPHY OF SCIENCE AND THE NATURAL REALM

Classification: The Inventory of Nature

From the sixteenth century through at least the eighteenth century the major objective of naturalists was the rationalization of the living realm by categorizing all plants and animals according to what were considered the specific characters which distinguish them from one another and signify their relationship with organisms of a similar kind. For example, botanists, starting in the sixteenth century, generally classified plants into their most basic units (species or genera) according to their fructifying parts and reproductive functions.[1]

Knowledge of plants and animals is dependent upon affixing

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[1]Phillip R. Sloan, "John Locke, John Ray, and the Problem of the Natural System," Journal of the History of Biology 5 (1972): 2-8. (Hereinafter referred to as "The Problem of the Natural System.") See also James L. Larson, Reason and Experience: The Representation of Natural Order in the Work of Carl von Linné (Berkeley, Los Angeles, London: University of California Press, 1971), chapter one.

For a discussion of Linnaeus' use of the sexual parts of plants in his system of classification see James L. Larson, "Linnaeus and the Natural Method," Isis 58 (1967): 304-20.

a proper name to their distinctive parts. A loss of the name means a loss of knowledge. Josef-Pitton de Tournefort (1656-1708) stated:

> To know plants is to know with precision the names that have been given to them in relation to the structure of some of their parts . . . . The idea of the character that essentially distinguishes plants from one another ought invariably to be one with the name of each plants.[2]

Later, Carolus Linnaeus (1707-1778) wrote:

> Hence the first step of wisdom is to know these bodies [plants, animals, and minerals]; and to be able, by those marks imprinted on them by nature, to distinguish them from each other, and to affix to every object its proper name.
>
> These are the elements of all science; this is the great alphabet of nature: for if the name be lost, the knowledge of the object is lost also; and without these, the student will seek in vain for the means to investigate the hidden treasures of nature.[3]

Although a minority, there were those naturalists, particularly in the seventeenth and eighteenth centuries, who denied that any one or any few parts or functions were capable of indicating the real, that is, natural, relationships between organisms. From their point of view, systems of classification based upon a few characteristics grouped plants and animals artificially and not in accord with the manner in which nature orders and organizes living things. In order to construct the most natural system, one must consider all of

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[2]Quoted in Michel Foucault, The Order of Things: An Archaeology of the Human Sciences, trans. unknown (New York: Pantheon Books, a Division of Random House, 1970), p. 139.

[3]Charles Linné, A General System of Nature, through the Three Grand Kingdoms of Animals, Vegetables, and Minerals; Systematically Divided into their several Classes, Orders, Genera, Species, and Varieties, with their Habitations, Manners, Economy, Structure, and Peculiarities, 7 vols., trans. William Turton, (London: Printed for Lackington, Allen and Co., 1802), 1: 3. (Hereinafter referred to as A General System of Nature.)

the parts of organisms.[4] As Michel Adanson (1727-1806), the French botanist, wrote:

> . . . les Méthodes de Botanike qui ne considèrent que 1 Partie, ou seulement un petit nombre de parties des Plantes, sont arbitrères, hypotétiques & abstractives, & ne peuvent être natureles, . . . [La] Métode naturele doit être unique, universele ou générale; c. à. d. ne soufrir aucune exception, & être indépendante de notre volonté, mais se régler sur la nature des êtres, qui consiste dans l'ensemble de leurs Parties & de leurs qualités; il n'est pas douteux qu'il ne peut i avoir de Méthode naturele en Botanike, que celle qui considère l'ensemble de toutes les parties des Plantes.[5]

Buffon agreed with Adanson that a system of classification based upon a full description of plants and animals is preferable to one in which only certain characters are considered. He was vehemently opposed to the use of any system, such as Linnaeus', based upon only one or a few parts of plants or animals. These systems are, according to Buffon, nothing more than abstract mental constructs. It is the primary purpose of this chapter to examine more closely Buffon's objections to what he considered the faulty philosophical foundation upon which most classificatory schemes are constructed.

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[4]John Ray (1627-1705) in the late seventeenth century, Buffon in the middle of the eighteenth century and Jean Baptiste Pierre Antoine de Monet de Lamarck (1744-1829) in the late eighteenth century, all objected to the idea that one or a few parts or functions of living things denoted their essential natures. (See Sloan, "The Problem of Natural System," pp. 1-53.)

[5]Michel Adanson, Familles des Plantes, 2 vols. (Paris: Chez Vincent, 1763), 1: clv. ". . . Botanical Methods which only consider one Part, or only a small number of the parts of Plants, are arbitrary, hypothetical and abstract, and cannot be natural, . . . The natural Method must be unique, universal or general, that is to say, suffer no exception and be independent of our will. It must be based on the nature of beings, which consists in the totality of their Parts and their qualities. There is no doubt that a natural Method in Botany can only be obtained when all of the parts of Plants are considered."

Scientific Knowledge and Living Things

Years before he started work on his major scientific production, the Histoire naturelle, Buffon was advocating the use of experiments to extract knowledge of the natural world. In 1735, in the preface to his translation of Hales' Vegetable Staticks, Buffon stated: "C'est par des Expériences fines, raisonnées & suivies, que l'on force la Nature à découvrir son secret; . . ."[6] It was the method

> du grand Newton; c'est celle que Messieurs de Verulam [Francis Bacon], Galilée, Boyle, Sthall ont recommandée & embrassée; c'est celle que l'Académie des Sciences s'est faite une loy d'adopter, & que ses illustres membres Messieurs Huygens, de Reaumur, Boerrhave, &c. ont si bien fait & font tous les jours si bien valoir; . . .[7]

Experiments and observations allow one, Buffon went on, to progress from a knowledge of particular effects to a knowledge of

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[6] [Stephen] Hales, La statique des vegetaux, et l'analyse de l'air trans. by [Georges-Louis Leclerc, comte] de Buffon (Paris: Chez Debure l'aîné, 1735), p. v. "It is by refined, reasoned, and coherent Experiments that one forces Nature to bare her secret; . . ."

According to Henry Guerlac and Rhoda Rappaport, Buffon was chiefly responsible for bringing Hales' Vegetable Staticks to the attention of the French scholars. (See Henry Guerlac, "The Continental Reputation of Stephen Hales," Archives internationales d'histoire des sciences, 30 [1951]: 398-99; and Rhoda Rappaport, "G.-F. Rouelle: An Eighteenth-Century Chemist and Teacher," Chymia, 6 [1960]: 94.)

For an excellent discussion of Hales' influence on Buffon see Hanks, Buffon avant l'"Histoire naturelle," pp. 89-101.

[7] Ibid., p. vi. "of the great Newton; it is the one which Messieurs Verulam [Francis Bacon], Galileo, Boyle, and Stahl have recommended and espoused; it is the one which the Academy of Sciences has made a law to adopt; and that its illustrious members Messieurs Huygens, de Reaumur, Boerhaave, etc. have made and are making everyday such good use of; . . ."

their causes and help one guard against that most egregious proclivity of the system builders, creating suppositions about Nature without ever consulting Nature herself.[8] Systems deal with principles -- principles which are purely gratuitous, have nothing to do with effects, and only serve as the base for abstract mental constructs. Observations and careful experiments will, however, save one from system building: "la connoissance des effets nous conduira insensiblement à celle des causes, & l'on ne tombera plus dans les absurdités, qui semblent caractériser tous les systêmes: . . ."[9]

Buffon's eschewing of systems and abstract ideas and his insistence upon the importance of the positive, factual basis of the natural sciences was not particularly novel in the eighteenth century. Many natural philosophers in the eighteenth century were convinced that Newton had shown the proper way to do science: frame no speculative hypotheses and only construct such theories as explain the phenomena.[10] That Newton framed many hypotheses and made many

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[8]Ibid., p. v.

[9]Ibid. "knowledge of effects will lead us gradually to knowledge of the causes, and we will no longer fall into the absurdities which seem to characterize all systems: . . ."

[10]Keith Michael Baker, Condorcet: From Natural Philosophy to Social Mathematics (Chicago and London: The University of Chicago Press, 1975), chapters two and three.

Some scholars contend that much of the eighteenth-century science was little influenced by Newton's science and was, as a matter of fact, at times anti-Newtonian. (See Lester G. Crocker, "Recent Interpretations of the French Enlightenment," Cahiers d'histoire mondiale 8 [1964]: 431; and Aram Vartanian, Diderot and Descartes: A Study of Scientific Naturalism in the Enlightenment [Princeton: Princeton University Press, 1953].)

Be that as it may, many natural philosophers seemed to have

speculations[11] and that his hypotheses and speculations constituted the intellectual font from which many natural philosophers, including Buffon, drew is not the point; the point is that the eighteenth-century anti-systematists thought that scientific thinking ought not to rest on mere postulates but rather ought to be the synthesis of the factual and the rational. Jean Le Rond l'Alembert (1717-1783) expressed the feelings of many savants when he wrote in his "Discours Préliminaire" to the famous Encyclopéide: "en bonne Philosophie, toute déduction qui a pour base des faits ou des vérités reconnues, est préférable à ce qui n'est appuyé que sur des hypothéses, même ingénieuses."[12]

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felt obligated to laud Newton's achievement and method (or what they considered to be his method). How deeply they were actually influenced by Newton or the Newtonian philosophy is another matter. Indeed, particularly in France, many savants continued to be deeply influenced by others, notably, Descartes and Gottfried Wilhelm von Leibniz (1646-1716).

[11]Isaac Newton, Opticks: Or, a Treatise of the Reflections, Refractions, Inflections and Colours of Light 2nd ed. (London: Printed for W. and J. Innys, 1718). See particularly Query number thirty-one on pages 350-82.

[12]Encyclopédie, ou Dictionnaire raisonné des sciences, des arts et des métiers, par une société de gens de lettres, s.v. "Discours Préliminaire," by [Jean Le Rond] d'Alembert, 1: ii. "in good philosophy, any deduction which has for a base facts or recognized truths is preferable to that which is supported only by hypotheses, no matter how ingenious." (Hereinafter referred to as Encyclopédie.)

Although d'Alembert and Buffon eventually became political rivals within the Académie Royale des Sciences, at the time of the publishing of the first volume of the Encyclopédie (1751), d'Alembert mentioned Buffon and his "Premier discours" to the Histoire naturelle with approbation. In response to d'Alembert's kind words, Buffon wrote that he was delighted and flattered at the way he had been treated. Buffon also assured d'Alembert that his own discourse was well written and even better reasoned. But, possibly thinking of

It was in the first volumes of the majestic Histoire naturelle, générale et particulière (1749), particularly in the "Premier discours; De la manière d'étudier & de traiter l'Histoire Naturelle," that Buffon expanded upon his objections to abstract systems and purely rational explanations of Nature and laid out the framework for a philosophy of science which was basically consistent with the eighteenth-century rejection of pure abstractions and idle speculation.[13] It was a philosophy that was to remain, for the most

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reaction to his own first volumes of the Histoire naturelle, Buffon warned d'Alembert that not everybody would appreciate his achievement. He said that the "Discours Préliminaire" to the Encyclopédie was "la quintessence des connaissances humaines, mais ce suc n'est pas fait pour tous les estomacs, et je crois que vous n'aurez d'abord que l'admiration des gens de beaucoup d'esprit, et qu'il faudra vous passer pour quelque temps du suffrage des autres. Les pédants surtout feront la grimace, et les sots, même les demi-sots, parleront beaucoup et ne vous entendront pas. Avec tout cela, ce morceau ne peut manquer d'avoir le plus grand succès." "the quintessence of human knowledge. But this juice is not made for all stomachs, and I think that you will at first only have the admiration of very intelligent people. It will be necessary for you to do without the suffrage of others for some time. The pedants especially will grimace, and the stupid, even the half stupid, will speak a good deal without understanding you. In spite of all this, this piece cannot fail to have great success." (See Georges-Louis Leclerc, comte de Buffon to Jean Le Rond d'Alembert, 20 June 1751, Georges-Louis Leclerc, comte de Buffon, Oeuvres complètes de Buffon, ed. by J.-L. de Lanessan, vol. 13: Correspondance [Paris: A. Le Vasseur, 1884], p. 82.)

For the dispute between Buffon and d'Alembert see Ronald Grimsley, Jean d'Alembert (1717-83) (Oxford: Clarendon Press, 1963), pp. 95-96.

[13]A number of critical works were published around the same time as the "Premier discours." Richard N. Schwab, in his introduction to his translation of d'Alembert's "Discours Préliminaire" to the Encyclopédie, wrote:

> "A remarkable cluster of critical works appeared at nearly the precise middle of the century: Montesquieu's Esprit des Lois (1748), Buffon's "Premier discours" to his Histoire naturelle (1749), Condillac's Traité des systèmes (1749), Turgot's Discours at the Sorbonne on the progress of the human mind (December, 1750), Rousseau's Discours [sur les Sciences et les Arts] (1750), and

part, unchanged throughout his life.[14] In these works Buffon amplified what he had already made clear in his preface to Hales' Vegetable Staticks: Nature cannot be coerced to fit the speculative abstractions of the system builders. Nature is a continuum totally full of existence and is more complex and varied than abstract systems would indicate. Philosophers who are not cognizant of -- or who ignore -- this and attempt to force Nature to fit abstract ideas and strictly rational constructs inevitably fail to understand Nature's design and the natural relationship between living things.

Buffon's belief that Nature is completely full of existence points to his commitment to an idea which was deeply embedded in Western man's view of the structure and order in the universe. The idea was that the variegated entities in Nature, both living and nonliving, somehow create a great connected whole. All natural existences form a unified hierarchy linked together like a great chain in

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Voltaire's Siècle de Louis XIV (1751). At this conjuncture of landmarks came the first volume of the Encyclopedia in June of 1751 with its Preliminary Discourse by d'Alembert." (See Jean Le Rond d'Alembert, Preliminary Discourse to the Encyclopedia of Diderot, trans. Richard N. Schwab [Indianapolis and New York: The Bobbs-Merrill Company, Inc., 1963], p. xxiv.)

For what is probably the first complete English translation of the "Premier discours" see John Lyon, "The 'Initial Discourse' to Buffon's Histoire naturelle: The First Complete English Translation," Journal of the History of Biology 9 (1976): 133-81.

[14]For example, Buffon denied the existence of natural genera until -- in 1766 -- he believed empirical evidence indicated that similar but different kinds of animals (horses, asses, and mules, for example) were reproductively compatible; that is, until he had evidence that a physical connection was made between two or more different species. (See Infra., pp.94-97.) After 1766, he thought the existence of genera sufficiently proved that in his volumes on birds (1770's) he used one species as a model for comparison with all other species belonging to the same genus. (See Infra., pp.97-98.)

which no breaks are discernible; one entity is so much like the next highest or lowest to it that no hiatus in the chain can possibly exist. To admit a break in the chain would be tantamount to admitting a lack of completeness in Nature as well as implying a lack of care on the part of God. Neither of these possibilities was tenable. Nature constitutes a plenum, and everything exists that must exist in order not to break the great chain of being.[15] Thus, asserted Buffon, Nature appears to man as an imperceptible series of nuances:

> Parcourant ensuite successivement & par ordre les différens objets qui composent l'Univers, . . . , il verra avec étonnement qu'on peut descendre par des degrés presqu'insensibles, de la créature la plus parfaite jusqu'à la matière la plus informe, de l'animal le mieux organisé jusqu'au minéral le plus brut; il reconnoîtra que ces nuances imperceptibles sont le grand oeuvre de la Nature; il les trouvera ces nuances, non seulement dans les granduers & dans les formes, mais dans les mouvements, dans les générations, dans les successions de toute espèce.[16]

His distrust of abstract systems combined with his belief in the chain of being made it impossible for Buffon to place faith in systems of classifying plants and animals as reflections of the natural order in the living world. Many classifiers -- and Linnaeus was the

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[15]Arthur O. Lovejoy, The Great Chain of Being (New York: Harper and Row, Publishers, 1936). Lovejoy discusses the eighteenth century and the great chain in chapters six, seven, and eight.

See Thomas L. Hankins, Jean d'Alembert, Science and the Enlightenment (Oxford: Clarendon Press, 1970), chapter five for the relationship between the idea of the great chain in Nature and the idea of the chain of all scientific knowledge.

[16]HN 1: 12-13. "Examining then successively and in order the different objects which compose the Universe, . . . , he will see with astonishment that we are able to descend from the most perfect creature down to the most unformed matter, from the best organized animal down to the most brute mineral by almost insensible degrees. He will recognize that these imperceptible nuances are the great work of Nature and he will discover these nuances not only in the sizes and shapes but in the movement, generation and succession of each species."

most guilty in Buffon's eyes[17] -- create systems of classification which misrepresent Nature's order: they contort and distort and finally divide the natural realm into arbitrary classes, apportion these classes into genera, and finally subdivide these genera into species. But man does not perceive such units in Nature. Living things are a concatenated sequence of entities without any discernible breaks, and no manner of compartmentalizing living things makes sense of the continuity between them:

> . . . la Nature marche par des gradations inconnues, & par conséquent elle ne peut pas se prêter totalement à ces divisions, puisqu'elle passe d'une espèce à une autre espèce, & souvent d'un genre à un autre genre, par des nuances imperceptibles; de sorte qu'il se trouve un grand nombre d'espèces moyennes & d'objets mi-partis qu'on ne sait où placer, & qui dérangent nécessairement le projet du système général: . . .[18]

Therefore, all taxonomic systems based on the idea that distinct divisions exist in Nature are artificial and divide plants and animals

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[17]In a letter to the Genevan physicist, Jean Jallabert (1712-1768), dated 2 August 1745, Buffon wrote the following:

"J'ai lu, l'année passée, à la séance publique de l'Académie des Sciences, un discours à ce sujet [on methods in botany], . . . et je conclus par faire voir que la méthode de Linnaeus est de toutes, la moins sensée et plus monstrueuse, . . ." "I have read the past year, at a public meeting of the Académie des Sciences, a discourse on this subject [on the methods in botany], . . . and I have shown that Linnaeus' method is of all the least sensible and the most monstrous, . . ." (See Piveteau, "Introduction," p. viii.)

For a good discussion of Buffon's objections to the Linnaean method see Phillip R. Sloan, "The Buffon-Linnaeus Controversy," Isis 67 (1976), 356-75.

[18]HN 1: 13. "Nature progresses by unknown gradations and consequently cannot totally submit to these divisions, since Nature passes from one species to another species and frequently from one genus to another genus by imperceptible nuances. We will find a great number of indeterminate species and in-between objects which we do not know where to place and which necessarily upset the project for a general system: . . ."

into-groups following a principle of arrangment in which there is of necessity an element of arbitrariness.[19]

Buffon complained that the same systematists who break the chain of being often choose one certain part of a creature's physical or temperamental makeup and base their method of classification upon that part. He insisted that one can never hope to understand the total creature by only studying one of its parts. Those who classify plants and animals into groups according to only one of their parts make an error in metaphysics: "Cette erreur consiste à méconnoître la marche de la Nature, qui se fait toûjours par nuances, & à vouloir juger d'un tout par une seule de ses parties: . . .[20]

In avoiding the errors of the systematists, the first objective in natural history is to obtain the "description complète & l'histoire exacte de chaque chose en particulier."[21] The history of

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[19]Ibid., pp. 13-15.

[20]Ibid., p. 20. "This error consists in misunderstanding the way Nature works, which is always by nuances, and in wanting to consider the whole by only one of its parts: . . ."

While finding much in the methods of the moderns to fault, Buffon found relatively little wrong with some of the ancients' methods of investigating plants and animals. Buffon judged Aristotle (384-322 or 321 B.C.), Theophrastus (c. 372-c. 288 B.C.), and Pliny (23-79) to be not only the first naturalists but also in certain respects the greatest. (See Ibid., p. 43.) Buffon praised Aristotle in particular, stating that his History of Animals was still better than the work of most Moderns. (See Ibid., pp. 43-44.) Buffon lauded Aristotle's careful collection of data relating to the life history of particular kinds of creatures. For example, in contrast to the modern naturalists, Aristotle collected much information regarding the shape of animals, their means of reproduction and generation, their gestation period, their living habits, and the environment in which they live. (See Ibid., pp. 45-46.)

[21]Ibid., p. 24. "complete description and exact history of each thing in particular."

each individual, however, must not be simply its own history "mais celle de l'espèce entière de ces animaux; . . ."[22] That is, the history of the individuals must cover such things as generation, mating periods, number of offspring, care of parents, education, instinct, habitat, food eaten, and the manner its food is procured.[23]

Buffon's assertion that the history of individuals must refer to the history of the whole species to which it belongs seems incongruous in light of the fact that he stated that there are no divisions in Nature; after all, the idea of species entails distinctions between groups of living things. It is not certain in the "Premier discours" exactly what Buffon meant by species, or how he meant to distinguish one species from another. But one thing is certain. Buffon did not mean to imply that species are separate entities from the individuals. All taxonomic groups are abstractions, and abstractions, as has been noted, Buffon believed are only inventions of the mind, which have nothing to do with the phenomena of organisms. Buffon was not saying that individuals do not share, for example, certain functions and certain forms with others of their kind; but these uniformities are found in the phenomena and are not due to some universal category.

A close attention to individuals and their history will yield uniform phenomena which are truths upon which the foundation of our physical (in contrast to abstract) knowledge is built:

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[22] Ibid., p. 30. "but that of the entire species of these animals; . . ."

[23] Ibid.

> - Les phénomènes qui s'offrent tous les jours à nos yeux, qui se succèdent & se répètent sans interruption & dans tous les cas, sont le fondement de nos connoissances physiques. Il suffit qu'une chose arrive toûjours de la même façon pour qu'elle fasse un certitude ou une vérité pour nous, tous les faits de la Nature que nous avons observés, ou que nous pourrons observer, sont autant de vérités, . . .[24]

By claiming that these physical truths -- these repeated phenomena -- serve as the base of our knowledge, Buffon meant that from them we can infer general effects which explain these same physical truths.[25] General effects are what we understand as the causes of the physical truths. And

> Ces effets généraux sont pour nous les vraies loix de la Nature; tous les phénomènes que nous reconnoîtrons tenir à ces loix & en dépendre, seront autant de faits expliqués, autant de vérités comprises; . . .[26]

Because general effects (the laws of Nature) have been discovered, Buffon did not think that the ultimate causes of existences have been discovered. What has been discovered is an effect of a first cause, which we cannot know or understand. First causes are beyond the world we experience: ". . . nos sens étant eux-mêmes les effets de causes que nous ne connoissons point, ils ne peuvent nous

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[24] Ibid., p. 57. "The phenomena which are offered each day to our eyes, which succeed and repeat themselves without interruption and in all cases, are the foundation of our physical knowledge. It is sufficient that a thing always happens in the same way for it to be a certitude or a truth for us. All the facts of Nature that we observe or that we are able to observe are so many truths, . . ."

[25] Ibid.

[26] Ibid. "These general effects are for us the true laws of Nature; all phenomena that we recognize holding to these laws and depending on them are so many facts explained, so many truths understood; . . ."

donner des idées que des effets, & jamais des causes; . . ."[27] We are then, reduced to calling a general effect a secondary cause of the facts of Nature and forgetting about first causes.

Furthermore, man should recognize and accept the fact that, because of these limitations placed upon his mind, the laws which he discovers are only relative to his nature. A law is an idea which only explains facts of Nature, but it itself is not a fact of Nature.[28] In short, all we can do is to perceive a few "effets particuliers, de les comparer, de les combiner, & enfin d'y reconnoître plutôt un ordre relatif à notre propre nature, que convenable à l'existence des choses que nous considérons."[29] Buffon, instead of d'Alembert, might have said that "la nature n'est pas obligée de se conformer à nos idées."[30] Man is limited in his understanding of Nature to his ability to construct laws which conform to the phenomena presented to him.

General Laws and Natural History

We should not conclude from what has been said that Buffon was adverse to all means of systematizing the living realm. Buffon

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[27] Ibid. ". . . our senses being themselves the effects of causes which we do not understand, they can lead us to ideas only of the effects and never of the causes: . . ."

[28] Ibid., pp. 57-58.

[29] Ibid., p. 12. "particular effects, to compare them, to combine them, and, finally, to recognize therein more of an order relative to our own nature than conforming to the existence of the things which we are considering."

[30] Encyclopedie, s.v. "Attractif," by d'Alembert, 1: 855. "nature is not obligated to conform to our ideas."

stated that the two equally dangerous obstructions in the study of natural history are (1) having no method of ordering the living realm at all and (2) attempting to relate everything to a particular system. The former leads to confusion, while the latter leads to abstract speculation. He stated that if one based his method upon knowledge of the entire organism, a basis for a natural method of classifying plants and animals would be possible:

> . . . il me paroît que le seul moyen de faire une méthode instructive & naturelle, c'est de mettre ensemble les choses qui se ressemblent, & séparer celles qui diffèrent les unes des autres. Si les individus ont une ressemblance parfaite, ou des différences si petites qu'on ne puisse les apercevoir qu'avec peine, ces individus seront de la même espèce; si les différences commencent à être sensibles, & qu'en même temps il y ait toûjours beaucoup plus de ressemblance que de différence, les individus seront d'une autre espèce, mais du même genre que les premiers; & si ces différences sont encore plus marquées, sans cependant excéder les ressemblances, alors les individus seront non seulement d'une autre espèce, mais même d'un autre genre que les premiers & les seconds, & cependant ils seront encore de la même classe, parce qu'ils se ressemblent plus qu'ils ne diffèrent; mais si au contraire le nombre des différences excède celui des ressemblances, alors les individus ne sont pas même de la même classe.[31]

But any system based purely upon the description of parts is

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[31] HN 2: 21. ". . . it appears to me that the only means of creating an instructive and natural method is to place together those things which resemble one another and separate those which differ. If the individuals resemble one another perfectly, or if the differences are so slight that we have difficulty perceiving them, they will be of the same species. If the differences begin to be perceptible but there are still greater similarities than differences the individuals belong to a different species but the same genus as the first. And if the differences are yet more marked, without, however, exceeding the resemblances, then the individuals will not only belong to another species but even to a different genus than the group to which the first and the second group belong. They will, nonetheless, belong to the same class, because they have more resemblances than differences. If, to the contrary, the number of differences exceeds the number of resemblances then the individuals are not even of the same class."

never entirely natural: it is impossible to understand everything that is necessary to construct a natural system. Buffon wrote:

> En approfondissant cette idée, on voit clairement qu'il est impossible de donner un système général, une methode parfaite, non seulement pour l'Histoire Naturelle entière, mais même pour une seule de ses branches; car pour faire un système, un arrangement, en un mot un méthode générale, il faut que tout y soit compris; . . .[32]

It is quite clear that Buffon -- even though recognizing a need for some sort of a classification scheme -- did not think that the traditional methods of classification could reveal a design consistent with man's experience of the organic world. The dedicated Newtonian that he was in physics, one might suppose that Buffon thought a mathematical language could denote the design of the living realm. That, however, is not the case. There are few subjects in sciences in which mathematics can be applied. Mathematical expressions, like the categories in a classification system, are pure abstractions which have nothing to do with the natural world. Unlike physical truth, they are not grounded in experience. Mathematical truths, Buffon stated, are nothing more than truths of definition, or "si l'on veut, des expressions différentes de la même chose, . . ."[33] Mathematical truths, consequently, have no reality.[34] It is true

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[32] Ibid., p. 13. "In examining this idea thoroughly, we see clearly that it is impossible to establish one general system, one perfect method, not only for the whole of Natural History, but for even one of its branches. Because in order to make such a system, an arrangement -- in a word a general method -- it is necessary for it to be all inclusive; . . ."

[33] Ibid., p. 54. "if one wants, different expressions of the same thing, . . ."

[34] Ibid., p. 54.

that there are certain limited natural phenomena which are expressible in mathematical symbols.[35] However, there must exist a very close correlation between the mathematical symbols and the natural phenomena. For example, mathematics is applicable to "l'Optique parce que la lumière étant un corps presqu'infiniment petit, dont les effets s'opèrent en ligne droite avec une vîtesse presqu'infinie, ses propriétés sont presque mathématiques, . . ."[36] The best example of the most beautiful and felicitous union between the physical world and mathematics is the Newtonian system.[37] Most subjects, however, are so complex that mathematical abstractions cannot be applied to them. If we try to apply mathematics to a too complex subject we are obliged to make "des suppositions toûjours contraires à la Nature, de dépouiller le sujet de la plûspart de ses qualités, d'en faire un être abstrait qui ne ressemble plus à l'être réel, . . ."[38]

How is man to demonstrate general effects (laws) in natural history, the most complex of all subjects, then? Through the use of observations Buffon believed that the principal facts of life can be ascertained and distinguished from facts which are merely accessory. Once the principal facts have been garnered, it is necessary to

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[35] Ibid., pp. 58-59.

[36] Ibid., p. 59. "Optics, because light being an almost infinitely small body, whose effects operate in a straight line with a nearly infinite velocity, its properties are almost mathematical."

[37] Ibid., pp. 58-59.

[38] Ibid., p. 61. "make suppositions which are always contrary to Nature, to strip the subject of most of its qualities, and to create an abstract being that has no resemblance to the real being."

> ensuite les lier ensemble par les analogies, confirmer ou détruire certains points équivoques, par le moyen des expériences, former son plan d'explication sur la combinaison de tous ces rapports, & les présenter dans l'ordre le plus naturel.[39]

Buffon recognized that la certitude physique, that is, knowledge obtained from "les phénomènes qui s'offrent tous les jours à nos yeux, qui se succédent & se répètent sans interruption . . . ,[40] is more trustworthy than knowledge obtained from analogies. In the "Essai d'arithmétique morale" (1777), he wrote:

> Il y a donc une distance prodigieuse entre la certitude physique & l'espèce de certitude qu'on peut déduire de la plupart des analogies; la première est une somme immense de probabilités qui nous force à croire; l'autre n'est qu'une probabilité plus ou moins grande, & souvent si petite qu'elle nous laisse dans la perplexité. Le doute est toujours en raison inverse de la probabilité, c'est-à-dire, qu'il est d'autant plus grand que le probabilité est plus petite.[41]

That is to say, knowledge induced from the direct experience of the phenomena is more reliable than suppositions derived from comparing different sets of phenomena. But, as Buffon stated in the "Premier discours," analogical reasoning must be used when dealing with the living realm.

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[39] Ibid., p. 62. "then connect the whole together by analogies, confirm or destroy certain equivocal points by means of experiments, form one's plan of explication on the combination of all these relationships, and present them in the most natural order."

[40] Ibid., p. 57. "phenomena which are offered each day to our eyes, which succeed and repeat themselves without interruption . . . ."

[41] HNS 4: 55. "There is therefore an enormous distance between the physical certitude and the kind of certitude that one can deduce from several analogies. The first is an immense sum of probabilities which we are forced to believe; the other is only a probability more or less great and often so small that it leaves us perplexed. Doubt is always in inverse ratio to the probability, that is to say, it is much greater when the probability is smaller."

It is not exactly clear in the "Premier discours" what Buffon intended to compare the phenomena of life to. What Buffon did make clear in the "Premier discours" is that man's knowledge of the living world is limited to his ability to demonstrate general effects which make the repeated phenomena exhibited by living things intelligible. Man, as Buffon insisted throughout the Histoire, cannot understand the real order in the living realm by forcing living things into the abstract, arbitrary categories of the systematists. It is not surprising that Buffon searched for the natural laws of life in the reproduction of beings, since reproduction is common to all organisms and is a phenomenon that occurs over and over again.

While Buffon's antipathy for abstract systems remained a guiding principle throughout the Histoire, at first glance it would appear that he broke with the idea that living Nature is an imperceptible continuity of life when he expressed a belief in the existence of species a very short time after he had written the "Premier discours." Whether in fact Buffon's accpetance of the existence of species constituted an intellectual shift away from what appears to have been a deeply felt conviction in the "Premier discours" or not will be addressed in part in the next two chapters.

CHAPTER IV

GENERATION AND THE CONCEPT OF SPECIES

Generation--the Key to the Species Concept

In the "Premier discours" Buffon seemed to vacillate between two seemingly irreconcilable positions in regard to the ontological status of species. On the one hand he stated that the general taxonomic groups into which the nomenclators place plants and animals are mere abstract inventions. The only existences in living Nature, Buffon contended, are individual beings. On the other hand, in the very same essay, he implied that species truly exist. As a matter of fact, he stated that a study of the life history of an individual is important only insofar as it relates to the history of the species to which it belongs. However, in the opening remarks of a large essay entitled "l'Histoire des animaux," written after but published the same year as the "Premier discours" (1749), there was no hint of vacillation; Buffon left no doubt that he believed in fixed, eternal species. He wrote:

> Cependant, quelqu'admirable que cet ouvrage nous paroisse, ce n'est pas dans l'individu qu'est la plus grande merveille, c'est dans la succession, dans le renouvellement & dans la durée

> des espèces que la Nature paroît tout-à-fait inconcevable. Cette faculté de produire son semblable, qui réside dans les animaux & dans les végétaux, cette espèce d'unité toûjours subsistante & qui paroît éternelle, cette vertu procréatrice qui s'exerce perpétuellement sans se détruire jamais, est pour nous un mystère dont il semble qu'il ne nous est pas permis de sonder la profondeur.[1]

Buffon, as he here stated, thought the reproduction and succession of like organisms to be at the heart of his concept of species. His concept was a functional and not an abstract one: by the natural processes of procreation individuals are able to perpetuate their organic likeness. The existence of the individual members of a species is not determined by some common transcendent quality, form, ideal type, or essential part. The term species itself is an abstract one, corresponding only to the destruction and renewal of beings throughout time. Species are thus only a constant succession of similar individuals which reproduce themselves.[2] The example often given to point out Buffon's definition of species is the one that he gave to identify the various animals which reproduce

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[1] HN., 2: 2-3. "However admirable this work appears to us, the greatest marvel nonetheless is not in the individual. It is in the succession, in the renewal, and in the duration of the species that Nature appears entirely inconceivable. This faculty of producing its own likeness, which resides in animals and plants, this kind of unity which always subsists and which appears eternal, this procreative virtue which is exerted perpetually without ever being destroyed is for us a mystery whose depth, it seems, we are not permitted to fathom."

See the following secondary sources for discussion of Buffon's concept of species: Farber, "Buffon's Concept of Species," pp. 115-52 and "Buffon and the Problem of Species," pp. 259-84; Lovejoy, "Buffon and the Problem of Species," pp. 84-113 in Forerunners of Darwin: 1745-1859 and pp. 467-73 and 554-67 in Popular Scientific Monthly; and Wilkie, "The Idea of Evolution," pp. 48-62, 212-227, and 255-266.

[2] HN., 4: 386.

sexually. According to Buffon, if a male and a female animal are able to produce fertile offspring after copulation, we know that they belong to the same species:

> . . . on doit regarder comme la même espèce celle qui, au moyen de la copulation, se perpétue & conserve la similitude de cette espèce, & comme des espèces différentes celles qui, par les mêmes moyens, ne peuvent rien produire ensemble; de sorte qu'un renard sera une espèce différente d'un chien, si en effet par la copulation d'un mâle & d'une femelle de ces deux espèces il ne résulte rien, & quand même il en résulteroit un animal mi-parti, une espèce de mulet, comme ce mulet, ne produiroit rien, cela suffiroit pour établir que le renard & le chien ne seroient pas de la même espèce puisque nous avons supposé que pour constituer une espèce, il falloit une production continue, perpétuelle, invariable, semblable en un mot, à celle des autres animaux.[3]

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[3] HN., 2: 10-11. ". . . we should regard as same species those individuals which by means of copulation are able to conserve and perpetuate the characteristics of their species; we should regard those animals as belonging to different species which by the same means are unable to produce anything; so that a fox will be a different species than a dog, if in fact by the copulation of a male and a female of these two species nothing results. And even if a bipartite animal, a kind of mule, results, since this mule can produce nothing, this would sufficiently establish that the fox and the dog would not be of the same species; for we have assumed that in order to constitute a species it is necessary that there be a continual, perpetual, invariable production, similar in a word, to that of other animals."

Among plants the identity of the species, however, is difficult to determine by means of sexual fecundity. It is not even certain, Buffon argued, that plants are sexual beings: they do not have any obvious sexual organs, and they are able to reproduce by asexual means. Ascertaining the identity of plants by a criterion based upon their sexual nature is, therefore, unreliable. But conspecificity of plants, as with all other living things, is defined in terms of their ability to reproduce their organic likeness. (See HN., 2: 11.)

The same sexual criterion would be unfit for those creatures which Buffon considered neither plant nor animal, such as polyps: they, like plants, have the ability to reproduce asexually. (See Infra., p. 71-72.

For a discussion of the functional nature of Buffon's species see Farber, "Buffon's Concept of Species," pp. 120-1 and Sloan, "The Buffon-Linnaeus Controversy," pp. 369-75.

Buffon's acknowledgement that species exist was not a sudden acceptance of the reality of universal abstractions, nor a rejection of his philosophy as presented in the "Premier discours." As a matter of fact his definition is consistent with la vérité physique as defined in that essay. As Phillip Sloan has recently put it, the species for Buffon

> are not the abstract universals of logic of the taxonomists but are rather systems of concrete relationship between real creatures at the level of physical truth. By defining species as 'a constant succession of similar individuals' or as the 'chain of successive existences of individuals' Buffon has in fact given a definition which satisfies in the biological domain what he has previously [in the "Premier discours"] defined as the essence of his physical truth--'a frequent repetition and uninterrupted succession of the same event.' Thus rather than introducing a radical departure from the argument of the Premier discours, Buffon is simply giving application to his a priori principles.[4]

Species, then, are the constant replication of distinct living forms. But how is this replication accomplished? Buffon needed to explain the succession of similar individuals within each species in such a manner that the causes of the replication of all the species would be the same. It would be inconsistent with his philosophy of science to explain the perpetuation of each species by different means: the same type of particular effects have a like cause. In other words, Buffon needed a general theory of reproduction which would explain the same physical fact (vérité physique) among each of the species -- the renewal of specific organic forms generation after generation. The problem, however, was complicated by the fact that the various species are quite different organic forms. Hence,

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[4]Sloan, "The Buffon-Linnaeus Controversy," p. 371.

Buffon needed to formulate a theory of generation which not only accounted for the fact that the laws of life and reproduction are fundamentally the same in all species but at the same time explained why there are real organic diversities among them.

Perhaps to contrast them with his own theory, Buffon felt obligated to attack several theories of generation which he thought relied upon metaphysical causes and abstract categories to explain the natural phenomenon of the reproduction of organisms.[5] The theory of generation which Buffon blasted with his most damaging and derisive verbal broadsides was the theory or pre-existence, which had gained predominance over other theories of generations by the beginning of the eighteenth century.[6] It has been stated by M. J. S. Hodge that Buffon sought especially to find an alternative to the emboîtement principle,[7] a principle popularized in the eighteenth century by Charles Bonnet (1720-1793), the Swiss naturalist, and his fellow countryman, Albrecht von Haller (1708-1777), the anatomist.[8] The essential point in the emboîtement principle is that the generations of new organisms are nothing more than expansions of pre-

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[5]See HN., 2: 73-120 for Buffon's objections to the theories of Plato (427 B.C.-348 or 347 B.C.), Nicolas de Malebranche (1638-1715), Leibniz, Aristotle, Descartes, William Harvey (1578-1657), and Hippocrates of Cos (c. 450 B.C.-?).

[6]Roger, Les sciences de la vie, pp. 364-84.

[7]M. J. S. Hodge, "Lamarck's Science of Living Bodies," The British Journal for the History of Sciences, 5 (1971): 324.

[8]Peter J. Bowler, "Preformation and Pre-existence in the Seventeenth Century: A Brief Analysis," Journal of the History of Biology, 4 (1971): 221. (Hereinafter referred to as "Preformation.")

existing germs which have existed since the creation of the universe, stored up in a seed or a particle of some sort one generation within another. The holders of this emboîtement conviction supposed that the original individuals of each species were the sources of all the succeeding generations; that is, the first individuals of each species contained within themselves all those others of their kind who have ever lived or who will ever live. The first individuals, according to the adherents of this theory, were created by God. According to some believers in the emboîtement principle, it was a male who first contained all the generations; others believed that a female was the source of all the members of her species.[9]

Before discussing Buffon's objections to the theory of pre-existence, it is necessary to distinguish between the theories of pre-existence and preformation. Preformation is often mistaken for pre-existence, but the two theories differ in a very fundamental way. They were different enough that Buffon's theory has some resemblances to the theory of preformation but was fundamentally opposed to the theory of pre-existence.[10] According to Jacques Roger, the doctrine of pre-existence is in some ways similar to the doctrine of preformation. Both doctrines maintain that there is no development of an embryo from a homogeneous matter; the organism is already entirely formed in the seeds of plants and the germs of animals: a living being's development is only a simple expansion of its parts. The

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[9]Ibid., pp. 221-44. See also Roger, Les sciences de la vie, pp. 325-53.

[10]Roger, Les sciences de la vie, pp. 542-58.

two doctrines differ in the source to which they trace the seeds or germs. The followers of preformation believed that the seed or germ of the organism is generated by the parent organism. The holders of the doctrine of pre-existence, on the other hand, did not believe that the seed and the germ are generated; they are created by God at the beginning of the world.[11]

The theory of preformation was an older theory than the theory of pre-existence. According to Roger, the theory of the preformation of germs was developed in the first years of the seventeenth century by physicians like Fortunio Liceti (1577-1657), Emilio Parisano (1567-1643), and Giuseppe degli Aromatari (1586-1660). They presented the theory as an answer to the seemingly insoluble problems posed by the animation of the seed or germ. The doctrine of pre-existence had its beginnings around 1660.[12]

The advent and expansion of the pre-existence theory was concomitant with the growing awareness that the rigid mechanist belief that beings are somehow generated from matter in motion was utterly inadequate in accounting for the complex phenomena surrounding the formation of a new living thing. There was a growing conviction in the early eighteenth century that the physical universe could not be responsible for generation. And yet these followers of pre-existence, imbued with the mechanical philosophy as they were, could not explain the formation of beings by appealing to vital forces,

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[11] Ibid., pp. 325-26.

[12] Ibid., p. 325.

occult powers, or any other nonmechanical cause. Their solution, as previously noted, was to deny the generation of beings altogether. All beings have existed from the beginning of time by the will of God. The miniatures created by God had only to expand their parts, and that could be explained mechanically.[13]

There were three major versions of the pre-existence theory: (1) the ovist emboîtement version, (2) the panspermist version, and (3) the animalculist emboîtement version. It was the ovist version -- the version that the pre-existing and preformed miniatures are the eggs of females -- that appeared first and had the most influence. One of the outstanding exponents of this version in the late seventeenth and early eighteenth centuries was Malebranche.[14] Malebranche described his version of emboîtement in his Recherche de la vérite´ (1674):

> Il ne paroît pas même déraisonnable de penser, qu'il y a des arbres infinis dans un seul germe; puisqu'il ne contient pas seulement l'arbre dont il est la semence, mais aussi un très-grand nombre d'autres semences, qui peuvent toutes renfermer dans elles-mêmes de nouveaux arbres, & de nouvelles semences d'arbres; lesquelles conserveront peut-être encore dans une petitesse imcomprehensible, d'autres arbres, & d'autres semences aussi fecondes que les premiéres; & ainsi à l'infini.
> . . . . . .
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> Ce que nous venons de dire de plantes & de leurs germes, se peut aussi penser des animaux, & du germe dont ils sont produits.[15]

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[13]Farber, "Buffon's Concept of Species," pp. 95-96. See also Bowler, "Preformation," pp. 236-44 and Roger, Les sciences de la vie, pp. 325-353.

[14]Bowler, "Preformation," pp. 240-41. See also Roger, Les sciences de la vie, pp. 336-339.

[15][Nicolas de] Malebranche, De la recherche de la vérité,

Claude Perrault (1608-1680) was largely responsible for the panspermist version of pre-existence.[16] Perrault was of the opinion that the miniatures float freely until absorbed by a parent organism, which presents it with the propitious circumstances in which to develop and grow. Bernard le Bovier de Fontenelle (1657-1757) reported in the Histoire de l'Académie Royale des Sciences that in 1679 Perrault had read to the Academy a treatise on the mechanics of animals. Near the end of the treatise, according to Fontenelle, Perrault proposed a new and bold idea on the generation of animals. Fontenelle stated that Perrault believed that the generating of animals is not a production, because it is impossible to conceive how a liquid of whatever kind or in whatever fermentation, could form an organized body. Rather, the generation of animals is a development of small, completely formed animals of all species -- animals which are scattered throughout the universe. These small animals, however, are not alive; they are too small to carry out the functions of life. They only wait for some sufficiently subtile liquid to

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2 vols., rev. 4th ed. (Amsterdam: Chez Henry Desbordes, 1688), 1: 39. "It does not appear unreasonable to even think that there are infinite numbers of trees in a single seed, since it contains not only the tree of which it is the seed, but also a very great number of other seeds which all can contain, shut up in themselves, new trees and new seeds of trees, which will keep, perhaps, in an incomprehensible smallness, other trees and other seeds as fertile as the first ones, and thus to infinity.

. . . . . .

What we have just said about plants and their seeds can be also thought of animals and of the seeds of which they are the products."

[16]Bowler, "Preformation," pp. 241-42.

penetrate into their pores and start the expansion of their parts.

> Cette liqueur, qui, pour ainsi dire, est la clef propre à ouvrir des machines si déliées, est avec la fermentation qui luî est nécessaire, la seule chose que les Animaux contribuent à la production de leurs pareils. La formation de la machine est un ouvrage trop merveilleux pour ne pas partir immédiatement de la main du Créateur.[17]

Animalculist emboîtement was the last version of pre-existence to appear. This version of pre-existence holds that all the generations of beings were encased within the first males.[18] Accord-

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[17][Bernard le Bovier de Fontenelle], Histoire de l'Académie Royale des Sciences, vol. 1: Histoire de l'Académie Royale des Sciences, depuis son etablissement en 1666. jusqu' à 1686 (Paris: Chez Gabriel Martin, Jean-Baptiste Coignard, fils, and Hippolyte-Louis Guerin, 1733), p. 280. "This liquid, which, so to speak, is the key fitted to such fine machines, is, along with the fermentation which is necessary to them, the only thing that animals contribute to the production of their duplicates. The formation of the machine is a work too marvellous not to have come immediately from the hand of the Creator."

[18]Stating that this version of pre-existence was the last to make its appearance seems to contradict the fact that Antoni van Leeuwenhoek (1632-1723) declared earlier than the appearances of either Malebranche's or Perrault's work that he had found animalcules in the seminal fluids of male animals. Indeed, Leeuwenhoek thought that the animalcules had the shape of miniature creatures and had developed from, as he called them, animals, or worms; but it cannot be ascertained for certain whether he thought his animalcules were miniatures. In an abstract of a letter printed in the Philosophical Transactions (1685) Leeuwenhoek made it clear that he did not believe that animalcules contained children, although, he stated, children come from them:

> "But this is a mistake [to think the sperm of men is full of small children], for I have only said its full of Animals, or Worms, with long Tails, whose figure I have often shewn. For as it is not proper to say, that Worms swimming in the water are flying Insects, tho' they come from them; or to say that the Kernal of an Apple is a tree, tho' a tree comes from it; so its no less improper to say, that the Worms in mens Seed are Children, tho' Children come from them." (See [Antoni van] Leeuwenhoek, "Concerning Generation by an Insect," Philosophical Transactions, no. 174, 15 [August 1685]: 1133.) And in another letter published in the Philosophical Transactions dated 9 June 1699 Leeuwenhoek wrote the following:

ing to Peter Bowler, the first to associate animalculism with emboîtement was Dr. George Garden (1649-1733) of Aberdeen, who referred to Perrault as the source of his belief in the pre-existence theory. However, the animalculist version never really challenged the ovist version.[19]

Buffon saw much to fault in the pre-existence theory, particularly the emboîtement doctrine inherent in ovism and animalculism. The whole idea that individuals are only expansions of miniature but fully developed beings encased one within another from the beginnings of time was anathema to Buffon; this idea removes the question of how individuals are formed from the legitimate province of scientific thought: individuals are not created by natural processes but by God's fiat. When the response to the question of how reproduction takes place is that "dans le premier être cette reproduction étoit toute faite, c'est non seulement avouer qu'on ignore comment elle se fait, mais encore renoncer à la volonté de le concevoir."[20] The emboîtement idea makes the reproduction of individuals, then, "un

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"I put this down as a certain truth, that the shape of a Human Body is included in an Animal of the Masculine Seed, but that a Mans Reason shall dive or penetrate into this Mistery so far, that in the Anatomizing of one of these Animals of the Masculine Seed, we should be able to see or discover, the intire shape of a Human Body, I cannot comprehend." (See [Antoni van] Leeuwenhoek, "Concerning the Animalcula in Semine humano, &c.," Philosophical Transactions no. 255, 21 [August 1699]: 306.)

[19]Bowler, "Preformation," pp. 242-43.

[20]HN., 2: 28. "in the first being this reproduction was totally made, it is not only to admit that we do not know how it is made, but yet renounce the desire of understanding [it]."

effet immédiat de la volonté de Dieu, . . ."[21] Questions concerning generation become "des questions de fait, dont il n'est pas possible de trouver les raisons: . . ."[22] Besides, Buffon asked, how is it possible for a theory of pre-existence to explain the resemblance of the offspring to their parents, sometimes to their mother, sometimes to their father, and sometimes to both parents?[23] And the notion that the first seed of a tree, for example, which is so minute, could be capable of nearly infinite propagation is sheer folly. The whole idea of pre-existence, Buffon stated, reduces the reproduction of the species to inexplicable obscurity.[24]

For these reasons Buffon found the dominant theory of generation in the first half of the eighteenth century sadly deficient as a cogent explanation of the reproduction of living things. What, then Buffon asked, is "le moyen caché que la Nature peut employer pour la reproduction des êtres?"[25] In 1746, as he penned this question, Buffon probably already had an answer.[26] The formulation of a

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[21] Ibid., p. 33. "an immediate effect of the will of God."

[22] Ibid. "questions of fact, for which it is not possible to find the reasons."

[23] Ibid., p. 158.

[24] Ibid., pp. 27-28.

[25] Ibid., p. 32. "the hidden means which Nature is able to employ for the reproduction of beings?"

[26] Ibid., p. 168. At the end of chapter five of the "Histoire des animaux," Buffon wrote: "Au Jardin du Roi, le 6 fevrier 1746." "At the Jardin du Roi 6 February 1746." And, in a document to l'Académie des Sciences dated 17 May 1748, Buffon wrote: Le 9 fevrier 1746, j'ai commencé un Traité sur la Génération, qui est maintenant

theory in which he explained his answer had not come easily for Buffon; it had occupied his attention for over a decade.

Some time after 1733, when he was discussing the problems of generation with Louis Bourguet (1678-1742), a naturalist and follower of Leibniz, and before 1746, when he had probably finished the first five essays of "l'Histoire des animaux," the work in which he explained his theory of generation, Buffon changed his mind at least once in regard to how organisms reproduce.[27] At one point during this period he was inclined to believe in an epigenetic theory in which attractive forces account for the appearance of the parts in an egg or a spermatic animalcule. Buffon wrote:

> j'employois les vers spermatiques & les oeufs des femelles, comme premières parties organiques qui formoient le point vivant, auquel par des forces d'attractions je supposois, comme Harvey, que les autres parties venoient se joindre dans un ordre symmétrique & [r]elatif, . . .[28]

This kind of theory, Buffon stated, could explain almost all of the phenomena associated with the generation of beings, although it could not explain heredity. After investigating this theory with care, Buffon rejected it.[29]

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entièrement achevé." "The ninth of February 1746 I started a Treatise on Generation, which is now entirely finished." (See Buffon to l'Académie des Sciences, 17 May 1748 in Correspondance, 1: 54.)

[27]Roger, Les sciences de la vie, pp. 542-43.

[28]HN., 2: 68. "I employed spermatic worms and the eggs of females as the first organic parts which formed the living point, to which by attractive forces I supposed, like Harvey, that the other parts come to join in a symmetrical and relative order."

[29]Ibid., pp. 68-69.

According to Jacques Roger, Buffon's rejection of his early beliefs regarding generation was due in some part to the long discussions over questions of heredity that he had with Pierre-Louis Moreau de Maupertuis (1698-1759) some time before 1744.[30] Buffon was impressed by Maupertuis' work on generation, at least as it is presented in the Vénus physique. Buffon stated that this short treatise by Maupertuis, printed in 1745, "rassemble plus d'idées philosophiques qu'il n'y en a dans plusieurs gros volumes sur la génération: . . ."[31] Buffon declared that Maupertuis was the first to start uncovering the true processes of generation. Buffon stated, "cet auteur est le premier qui ait commencé à se rapprocher de la vérité dont on étoit plus loin que jamais depuis qu'on avoit imaginé les oeufs & découvert les animaux spermatiques."[32]

What was it that so impressed Buffon about Maupertuis' short

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[30]Roger, Les sciences de la vie, p. 543.

John Turberville Needham (1713-1781), who collaborated with Buffon in early 1748 in experiments to prove the existence of organized beings in the seminal fluids of various animals, wrote that Maupertuis and Buffon had often discussed problems of generation. Needham said:

> "He [Buffon] had been long dissatisfy'd with the Opinion of pre-existent Germs in Nature; and he and Mr. Maupertuis, President of the Academy of Sciences at Berlin, had often discours'd together upon the Subject." (See [John] Turberville Needham, "A Summary of some late Observations upon the Generation, Composition, and Decomposition of Animal and Vegetable Substances . . . ," Philosophical Transactions, no. 490, 45 [December 1748]: 633.)

[31]HN., 2: 164. "brings together more philosophical ideas than exist in several large volumes on generation."

[32]Ibid. "This author is the first who has started to approach the truth, which was further removed than ever after eggs had been invented and spermatic animals had been discovered."

work? As noted above, Buffon was a confirmed Newtonian long before the publication of Maupertuis' work and long before he became interested in theories of generation, and the fact that Maupertuis employed attractive forces in the Vénus physique in order to explain many natural phenomena probably made the work as a whole appealing to Buffon. Maupertuis quoted Etienne-François Geoffroy's (1672-1731) law of relations as an example of how the combination of substances can be explained by attractive forces. Maupertuis was of the opinion that Geoffroy referred to relations rather than forces because he thought that the idea of forces would not be received favorably by the Académie royale des Sciences, the body to which Geoffroy presented his law. The law is as follows:

> toutes les fois que deux substances qui ont quelque disposition à se joindre l'une avec l'autre, se trouvent unies ensemble; s'il en survient une troisieme qui ait plus de rapport avec l'une des deux, elle s'y unit en faisant lâcher prise à l'autre.[33]

Maupertuis used such a theory of affinities to explain the

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[33][Pierre-Louis Moreau] de Maupertuis, Les Oeuvres de Mr. de Maupertuis (Dresde: Chez George Conrad Walther, 1752), p. 247. "Whenever two substances which have some disposition to join with one another are found united, if a third crops up which has a greater rapport with one of them, it unites with it, loosening the grasp of the other."

According to Robert E. Schofield, Geoffroy did not conceive of his "rapports" as forces. Rather, noted Schofield, Geoffroy "avoids the use of attractive forces and speaks only of 'rapports.'" (See Robert E. Schofield, "The Counter-Reformation in Eighteenth-Century Science--Last Phase," in Perspectives in the History of Science and Technology, ed. Duane H. D. Roller, Norman: University of Oklahoma Press, 1971, p. 47.) Stahlian chemists, such as Geoffroy, Schofield continued, avoided any attempt to reduce chemical elements to the action of attractive and repulsive forces between differently shaped and sized but homogenous bits of matter. Stahlians believed that chemical elements have qualities which cannot be reduced to matter and forces. (See Ibid., pp. 45-50.)

formation of animal bodies. Given the existence of attractive forces, the formation of a fetus could be explained in the following manner: there are semen particles from both the mother and the father which are predetermined to form the heart, the head, the arms, etc., and if these particles have a "plus grand rapport d'union avec celle qui pour la formation de l'animal doit être sa voisine, qu'avec tout autre; la foetus se formera: . . ."[34] We should not believe that there are in the two semens the precise number of particles needed to form a fetus, or the precise number that the female can carry. Each sex provides many more particles than is necessary.[35]

Although it was much more detailed and much more sophisticated, Buffon's 1746 solution to the problems of generation was, in certain respects, closer to Maupertuis' than any other contemporary solution. Buffon even wrote that general views differing little from his own can be found in Maupertuis' Vénus physique.[36] Essential to Buffon's theory of generation are three necessary factors: (1) active, indestructible, and eternal organic molecules, which constitute the bodies of organisms; (2) moules intérieurs (interior molds), which sustain and perpetuate the organic forms by organizing the organic molecules properly within the bodies; and (3) attractive forces, which are responsible for the organic molecules penetrating

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[34] Ibid., p. 248. "greater harmony of union with that which for the formation of the animal must be its neighbor than with any other, the fetus will be formed."

[35] Ibid.

[36] HN., 2: 164.

the interior parts of living bodies. With these three essential elements, Buffon thought he could explain all the phenomena of living beings and avoid what he believed to be the metaphysical characteristics of most other theories of generation.

Buffon's Organic Molecules and the Moule Intérieur

In an essay entitled "De la reproduction en general," (1749) Buffon stated that there are primitive organic parts (later in the Histoire he preferred to call them molecules or particles) of an infinite number which compose the substance of all living things, just as there are brute particles which compose inorganic things.[37] These particles are primitive, indestructible,[38] and unvarying. The cause of death in organized beings, then, cannot be due to the destruction of these particles; the death of living things results when the organic molecules are separated from bodies to which they once belonged.[39]

Because Buffon wrote of organic molecules as the unique building material of living beings -- and in this manner contrasted them with nonliving particles -- it should not be assumed that he meant to create a dichotomy of the world into two categorically different realms -- the living and the nonliving. He stated in the second chapter of "l'Histoire des animaux" (1749) that "le vivant &

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[37] HN., 2: 20.

[38] Ibid., p. 24.

[39] Ibid., p. 44.

l'animé, au lieu d'être un degré métaphysique des êtres, est une propriété physique de la matière."[40] Later in "l'Histoire des animaux," Buffon stated that inorganic matter is merely dead matter -- matter that had once been alive.[41]

The belief that there are no distinguishing qualities between organic and inorganic matter permeates the entire Histoire naturelle. In 1765, in the "Seconde vue de la nature," Buffon, however, rejected the idea that all matter was either animated or dead. Possibly because the idea that all matter is organic was too close to hylozoism. Buffon eventually attempted to explain the existence of the organic molecules by appealing to the actions of active forces on certain kinds of brute matter. First asserting that a penetrating force (the same force that causes large bodies to act upon one another from a distance) animates each atom of matter[42] and causes all the phenomena of brute matter, Buffon wrote that organic molecules somehow result from a combination of this force and heat:

> . . . une seule force est la cause de tous les phénomènes de la matière brute, & cette force réunie avec celle de la chaleur, produit les molécules vivantes desquelles dépendent tous les effets des substances organisées.[43]

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[40] Ibid., p. 17. "the living and the animated, rather than being a metaphysical degree of beings, is a physical property of matter."

[41] Ibid., p. 39.

[42] HN., 13: v.

[42] Ibid., p. xx. ". . . one force alone is the cause of all the phenomena of brute matter, and this force joined with that of heat produces living molecules upon which all attributes of organized substances depend."

In his "Introduction a l'histoire des mineraux" (1774),

And in his famous "Des Époques de la Nature," published in 1778, Buffon wrote that the organic molecules are produced by heat acting

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Buffon wrote: "Les puissances de la Nature, autant qu'elles nous sont connues, peuvent se réduire à deux forces primitives, celle qui cause la pesanteur, & celle qui produit la chaleur." (See HNS., 1: 1. "The powers of Nature, as far as we know, can be reduced to two primitive forces: that which causes gravity and that which produces heat.") Although Buffon here, and in the quotation above taken from the "Seconde vue de la nature" (1765), seemed to be arguing for the existence of two equally dominant forces in Nature, the repulsive force which causes heat can be traced back to attraction:

> "La force expansive pourroit donc bien n'être dans le réel que la réaction de la force attractive, réaction qui s'opère toutes les fois que les molécules primitives de la matière, toujours attirées les unes par les autres, arrivent à se toucher immédiatement; car dès-lors il est nécessarie qu'elles soient repoussées avec autant de vitesse qu'elles en avoient acquis en direction contraire au moment du contact, & lorsque ces molécules sont absolument libres de toute cohérence, & qu'elles n'obéissent qu'au seul mouvement produit par leur attraction, cette vîtesse acquise est immense dans le point du contact. La chaleur, la lumière, le feu qui sont les grands effets de la force expansive, seront produits toutes les fois qu'artificiellement ou naturellement les corps seront divisés en parties très-petites, & qu'ils se rencontreront dans des directions opposées; & la chaleur sera d'autant plus sensible, la lumière d'autant plus vive, le feu d'autant plus violent que les molécules se seront précipitées les unes contre les autres, avec plus de vîtesse par leur force d'attraction mutuelle." (See HNS., 1: 9-11. "The expansive force will appear, therefore, to be really only the reaction of the attractive force -- a reaction which operates anytime that primitive molecules of matter, which are always attracted to one another, succeed in directly touching. At once it is necessary that they be repelled with as much velocity as they had acquired in the contrary direction at the moment of contact. When these molecules are absolutely free of all coherence and only obey the movement produced by their attraction alone, this acquired velocity is immense at the point of contact. Heat, light, and fire, which are the great effects of the expansive force, will be produced anytime that bodies are artificially or naturally divided into very small parts and they encounter one another in opposite directions. Heat will be much more sensible, light much swifter, and fire much more violent when the molecules are hurled against one another with most of the velocity produced by their mutual attraction."

For a discussion of Buffon's view of heat see Robert James Morris, Jr., "Eighteenth-Century Theories of the Nature of Heat" (Ph.D. dissertation, The University of Oklahoma, 1965), pp. 46-51.

Buffon, unlike most eighteenth-century British Newtonians,

upon ductile matter.[44] Still later, in the first volume of l'Histoire naturelle des minéraux, published in 1783, Buffon stated that the force of heat joined with the attractive force produces organic molecules from brute matter.[45] He said: ". . . la force pénétrante de l'attraction jointe à celle de la chaleur produisent les molécules organiques, & donnent le mouvement à la matière brute. . . ."[46] Also in the first volume of l'Histoire naturelle des minéraux Buffon wrote that the organic molecules could only be produced from matter that is ductile and soft.[47]

No matter how these molecules are activated, new supplies of them are nonetheless essential for the continued existence of living things. The ever new infusion of organic molecules sustains the basic functions of all organisms: nutrition, growth, and reproduction. Organisms acquire new supplies of organic matter by taking in food. During nutrition the organic parts which are taken into the body are separated from the inorganic parts. After its separation from the inorganic material and after being carried throughout the

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was convinced that attractive forces alone could explain all the phenomena exhibited by brute matter. (See Arnold Thackray, Atoms and Powers: An Essay on Newtonian Matter-Theory and the Development of Chemistry [Cambridge: Harvard University Press, 1970], pp. 155-60.)

[44] HNS., 5: 186.

[45] HNM., 1: 5.

[46] Ibid., p. 9. ". . . the penetrating force of attraction joined to that of heat produces the organic molecules, and gives movement to brute matter."

[47] HNM., 1: 6.

body by means of the circulatory system, the organic matter is then assimilated into the substance of the various parts of the plant or animal.[48] The inorganic parts are passed out of the body via perspiration and other excretory means.[49] The organic molecules are recycled from plants to animals and back to plants incessantly, allowing all organic things to continue living. This matter by "passant des végétuax aux animaux par la voie de la nutrition, retournant des animaux aux végétaux par celle de la putréfaction, circule incessamment pour animer les êtres: . . ."[50]

The organic molecules cannot alter the form of living beings, although they penetrate their bodies. The form of the body is fixed. The organic molecules can only augment a body's bulk; that is, they add the needed material for the body's growth. Hence, as the organic molecules are taken into the body they enter "un certain ordre relatif à cette forme, . . ."[51]

In order to explain not only how the organic molecules conform to the configuration of the body but also how reproduction of living creatures is possible, Buffon used what he called the moule intérieur.[52] Buffon saw nothing untoward in maintaining that if

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[48] HN., 2: 63-64.

[49] Ibid., p. 44.

[50] HN., 14: 26. "passing from plants to animals by way of nutrition and then returning again to the plants by way of putrefaction, circulates incessantly in order to give life to beings."

[51] HN., 2: 46. "a certain order relative to this form."

[52] Ibid., pp. 34-35.

there are molds which we can make to shape the exterior figure of bodies there ought also to be moules intérieurs which Nature uses to give living things their interior form and which makes the reproduction of living things possible. Nature "peut les [moules intérieurs] avoir, comme elle a les qualités de la pesanteur, qui en effet pénètrent à l'intérieur [of bodies]; . . ."[53] We cannot have a clear idea of interior forces or moules intérieurs, however, because our senses can only produce representations of the surface of things.[54] But

> Si nos yeux, au lieu de ne nous représenter que la surface des choses, étoient conformés de façon à nous représenter l'intérieur des corps, nous aurions alors une idée nette de cet intérieur, sans qu'il nous fût possible d'avoir par ce même sens aucune idée des surfaces; dans cette supposition les moules pour l'intérieur, que j'ai dit qu'emploie la Nature, nous seroient aussi faciles à voir & à concevoir que nous le sont les moules pour l'extérieur, & même les qualités qui pénètrent l'intérieur des corps seroient les seules dont nous aurions des idées claires, . . .[55]

The supposition that moules intérieurs exist is based upon good analogies, then, but does it contain any contradictions? Buffon

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[53]Ibid., p. 35. "Nature can have them [moules intérieurs], as she has the qualities of gravity, which in fact penetrate into the interior [of bodies]; . . ."

[54]Ibid., p. 34.

[55]Ibid., p. 35. "If our eyes, instead of representing to us the surfaces of things, were constructed in such a manner that they represented to us the interior of bodies, we would then have a clear idea of that interior, without it being possible for us, with these same senses, to have any idea of the surfaces. Upon this supposition, the moules for the interior, which I have said Nature employs, would thus be easy to see and to conceive as are moules for the exterior, and the very qualities which penetrate the interior of bodies would be the ones of which we had clear ideas, . . ."

knew perfectly well that the term moule intérieur contains two ideas which appear to be contradictory: the idea of a mold is related only to the surface of matter and that of an interior mold is related to the mass. It is, Buffon admitted, as if "on vouloit joindre ensemble l'idée de la surface & l'idée de la masse, & on diroit tout aussi-bien une surface massive qu'un moule intérieur."[56] But, Buffon said, in order to grasp the idea of things that are outside of our world of experience at times it is necessary to use terms which appear to contradict the idea we are trying to convey. Be that as it may, there is only a contradiction between the terms mold and moule intérieur; the idea of the moule intérieur is not in contradiction with the idea of a mold, for moule intérieur is a simple idea; that is, it is a unified idea, a fundamental idea, an idea without compound features, and contains no other idea.[57]

Simple, that is, pure ideas, such as moules intérieurs, cannot contain and be contradicted by other ideas, but they are first apprehensions of our sense which require a comparison with some standard. If, for example, the standard unit of measurement is a circular line instead of a straight line, it will be found that one can measure the circumference of a circle but not its diameter.[58] Thus, "l'idée de la grandeur d'un objet ou de son éloignement renferme

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[56]Ibid., pp. 35-36. "we wanted to join together the idea of the surface and the idea of the mass, and with equal propriety speak of a massive surface as well as a moule intérieur."

[57]Ibid., p. 36.

[58]HNS., 4: 137.

nécessairement la comparaison avec une unité de grandeur ou de distance; . . ."[59] The idea of a moule intérieur is a simple idea which can only be grasped if compared with gravity:

> Telle est l'idée du moule intérieur; je connois dans la Nature une qualité qu'on appelle pesanteur, qui pénètre les corps à l'intérieur, je prends l'idée du moule intérieur relativement à cette qualité; cette idée n'enferme donc qu'un comparaison, & par consequent aucune contradiction.[60]

Several present-day scholars have understood Buffon to have been saying here that moules intérieurs are active forces, but he was not saying that. He was saying that in order to comprehend or grasp the idea of moules intérieurs one must compare it with gravity. Buffon appears to have meant that the idea of moules intérieurs would be incomprehensible without our knowledge that there are other occult qualities which operate upon the interior of bodies. Other commentators have called the moule intérieur a power which gives the shape and configuration to the organic molecules that enter the bodies of organisms, a molding principle, and an organizer whose mission is the regulation of the flow and the distribution of the organic molecules.

Paul Farber has stated that Buffon conceptualized the moule intérieur as a force similar to Newton's gravitational force. Farber

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[59]HN., 2: 36. "the idea of the size of an object or of its distance necessarily contains the comparison with a unity of size or of distance."

[60]Ibid., p. 37. "Such is the idea of moule intérieur: I know about a quality in Nature that is called gravity, which penetrates bodies into the interior. I grasp the idea of the moule intérieur in relation to this quality. This idea contains, therefore, only a comparison and consequently no contradiction."

argued that Buffon's analogy between gravity and the moule intérieur creates anomalies. For example, whereas gravity is a universal force common to all matter, the moule intérieur is a collection of individual forces, influencing only certain organic molecules and not others. Furthermore, Farber wrote, the moule intérieur is a teleological force in that it arranges organic matter according to an intrinsic plan, while gravity is a universal property of all matter which acts uniformly. Farber conjectured that when Buffon compared his moule intérieur to gravity he was perhaps thinking of the other active principles which Newton posited in the thirty-first query of the Opticks.[61]

Otis E. Fellows and Stephen F. Milliken have stated that it is best to translate moule intérieur as "interior molding force." They state that the "only efforts he [Buffon] made to describe the moule intérieur took the form of comparisons with gravitation and matter's other 'obscure forces.'"[62]

Elizabeth B. Gasking explained that "Buffon believed that each organism possessed a force or property, which he called the 'interior mould' (moule intérieur)."[63] This mold imposes upon identical particles the form which is peculiar to the individual.[64] Buffon conceived of this force, according to Gasking, as an active

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[61]Farber, "Buffon and the Concept of Species," pp. 263-65.

[62]Fellows and Milliken, Buffon, p. 94.

[63]Elizabeth B. Gasking, Investigations into Generation 1651-1828 (London: Hutchinson & Co. Ltd., 1967), p. 88.

[64]Ibid.

force; as a matter of fact, "Buffon was so impressed with Newtonian Physics that he was prepared to suggest that the moule intérieur was probably an attractive force."[65]

Robert Wohl, while not maintaining that the moule intérieur itself is a force, suggested that it exerts a force. Wohl wrote:

> . . . Buffon deliberately made the comparison between the existence of attraction and the force which the moule exerted on the organic molecules in maintaining the proper proportions of growth and reproduction.[66]

Wohl referred to the moule intérieur as a mechanism which gives form to organic matter and controls generation, development, and reproduction.[67]

Phillip Sloan has written that Buffon, in order to explain the problem of the form and organization of the embryo from material particles in motion, "summons the activity of Newtonian-type penetrating forces between the organic molecules."[68] According to Sloan, Buffon conceived that

> the operation of these attractive forces, setting up veritable type-specific fields of force, provides his theoretical resolution of the problem with a concept of implicit substantial forms, the moules intérieures, serving as the ultimate efficient and formal causes of biological phenomena. . . .[69]

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[65]Ibid., p. 93.

[66]Robert Wohl, "Buffon and His Project for a New Science," Isis 51 (1960): 192.

[67]Ibid.

[68]Sloan, "The Idea of Racial Degeneracy in Buffon's Histoire Naturelle," p. 301.

[69]Ibid.

According to Sloan, apparently, the moules intérieurs are substantial forms as well as fields of force.

Carlo Castellani has informed us that the term moule intérieur has a purely semantic character. Castellani stated: "Indeed, he advised explicitly that he is using the term 'mold' for lack of a word capable of indicating with greater clarity that which he wishes to define."[70] Whatever the term moule intérieur means, its purpose, Castellani wrote, is that of an organizer; it is assigned the task of

> regulating the flow of photoplasmatic material furnished by the digestive processes, and of controlling its distribution in accordance with the schemata inherent in the 'biological memory' of the specific organ, and of each of its individual parts.[71]

John C. Greene has written that the moule intérieur is a "force or principle which organized the molecules into animate bodies and governed their distribution and behavior. . . ."[72]

Both Jacques Roger and Peter Bowler have contended that Buffon's moules intérieurs and active forces are two different kinds of things. Roger has written, however, that Buffon's moules intérieurs, although inert and passive, give the organic matter absorbed into bodies its internal and external configurations. The entire body and the different organs of the more complex animals are all moules

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[70]Carlo Castellani, "The Problem of Generation in Bonnet and in Buffon," in Science, Medicine and Society in the Renaissance: Essays to Honor Walter Pagel, 2 vols., ed. Allen G. Debus (New York: Neale Watson Academic Publishers Inc., 1972), 2: 277.

[71]Ibid., pp. 277-78.

[72]John C. Greene, The Death of Adam: Evolution and its Impact on Western Thought (New York: The New American Library of World Literature, Inc., 1961), p. 147.

intérieurs. A more active force according to Roger, was needed by Buffon to explain the interpenetration of the molecules into the moules intérieurs.[73] According to Peter Bowler, "the mold is nothing more than the structure of the organism itself, . . ."[74]

Indeed, as Roger and Bowler have said, Buffon did conceive of the bodies of organisms as acting as moules intérieurs which relate not only to the surfaces of bodies but which also extend their influence into the interior parts of living things:

> Il nous paroit donc certain que le corps de l'animal ou du végétal est un moule intérieur qui a une forme constante, mais dont la masse & le volume peuvent augmenter proportionnellement, & que l'accroissement, ou, si l'on veut, le développement de l'animal ou du végétal, ne se fait que par l'extension de ce moule dans toutes ses dimensions extérieures & intérieures, que cette extension se fait par l'intussesception d'une matière accessoire & étrangère qui pénètre dans l'intérieur, qui devient semblable à la forme, & identique avec la matière du moule.[75]

Much later, in the "Seconde vue de la nature," (1765) he called the bodies of organisms moules which assimilate the organic molecules: "Le corps de chaque animal ou de chaque végétal, est un moule auquel s'assimilent indifféremment les molécules organiques. . . ."[76] In

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[73]Roger, Les sciences de la vie, pp. 546-47.

[74]Bowler, "Bonnet and Buffon," p. 268.

[75]HN., 2: 42-43. "It therefore appears certain to us that the body of an animal or of a plant is a moule intérieur which has a constant form but whose mass and volume can be augmented proportionally. The growth, or, if you want, the development of the animal or the plant, takes place only by the extension of this moule in all of its external and internal dimensions. This extension is accomplished by the intussusception of an accessory and foreign matter which penetrates into the interior and which becomes similar to the form and identical with the matter of the moule."

[76]HN., 13: vii. "The body of each animal or of each plant is a moule which assimilates indifferently organic molecules. . . ."

the least complex creatures, that is, organisms without distinct parts, such as polyps, the entire body acts as one moule intérieur;[77] in the more complex animals the entire body and every one of its different parts are so many moules intérieurs.[78]

These bodies of organisms, which are moules intérieurs, are passive powers. In the "Additions à l'histoire des animaux" (1777), Buffon stated that these passive powers determine only the direction of the movement and the position of the organic molecules. The moules intérieurs do not, however, cause the motion of the organic molecules. Buffon said:

> Ces molécules organiques toujours actives, toujours subsistantes, appartiennent également à tous les êtres organisés, aux végétaux comme aux animaux; . . . , & la font servir de base au tissu de l'organisation, de laquelle ces molécules vivantes sont les seuls principes & les seuls instrumens; elles ne sont soumises qu'à une seule puissance qui, quoique passive, dirige leur mouvement & fixe leur position. Cette puissance est le moule intérieur du corps organisé, les molécules vivantes que l'animal ou le végétal tire des alimens ou de la sève, s'assimilent à toutes les parties du moule intérieur de leur corps, elles le pénètrent dans toutes ses dimensions, elles y portent la végétation & la vie, elles rendent ce moule vivant & croissant dans toutes ses parties; la forme intérieure du moule détermine seulement leur mouvement & leur position pour la nutrition & le développement dans tous les êtres organisés.[79]

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[77]HN., 2: 47.

[78]Ibid., p. 42.

[79]HNS., 4: 338-39. "These always active, always subsisting organic molecules belong equally to all organized beings -- to plants as well as animals -- and serve as the base for the tissue of organization, of which the living molecules are the only principles and the only instruments. They are subject to only one power which, although passive, directs their movement and fixes their position. This power is the moule intérieur of the organized body. The living molecules that the animal or the plant pulls from the aliment or from the sap is assimilated into all parts of the moule intérieur of their bodies;

The most that can be said, after considering the above quotations, is that Buffon seemed to have meant that the bodies of organisms are moules intérieurs which are able to assimilate organic molecules into their interior and there shape and arrange them according to the external and internal configuration of each of its parts. The proper shaping and arrangement of each molecule into the part of the body into which it is assimilated assures the continued processes of life: nutrition, growth, and reproduction. Roger's characterization of the moule intérieur seems, then, the closest to what Buffon had in mind.

But contrary to Farber, Fellows, Milliken, and Gasking it cannot be said that the moules intérieurs are active forces. As a matter of fact, Buffon thought that they are effects of the one active force which causes all of the phenomena of Nature -- the attractive force of gravity.[80] The action of the attractive force and heat (as noted earlier in the chapter, heat results from the action of the attractive force on very small particles) working organic molecules into the interior of ductile matter results in the formation of moules intérieurs. The attractive power allows the organic molecules to penetrate the ductile matter and heat distributes them (it will be remembered that heat is associated with expansion of matter) in

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they penetrate it in all its dimensions; they carry vegetation and life to it; they make this moule living and growing in all of its parts. The interior form of the moule determines only their [the molecules] movement and their position for nutrition and development in all organized beings."

[80] HNM., 1: 5-6.

equal proportions so that nutrition and growth follow. Buffon stated in the first volume of the Histoire naturelle des minéraux (1783) that

> pour former un moule d'animal ou de végétal capable de se reproduire, il faut que la Nature travaille la matière dans les trois dimensions à la fois, & que la chaleur y distribue les molécules organiques dans les mêmes proportions, . . .[81]

Whatever else these moules intérieurs are, they are not the active forces or powers which cause the interpenetration of the organic molecules into the body. This is accomplished by what Buffon called "the penetrating force." This force penetrates into the interior of organized bodies and pushes forward or attracts the organic molecules into the moules intérieurs, allowing the body of the individual to be nourished, grow, and provide the necessary particles for the development of embryoes.[82]

As is true with all interior qualities of matter, one will never have a clear idea of what these penetrating forces are or how they operate, for "elles ne sont pas du genre de choses que nous puissons apercevoir; . . ."[83] But "en même temps il n'est pas moins certain qu'elles existent, . . ."[84] One should not discount their existence merely because they are occult. Matter should not be

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[81] Ibid., p. 7. "in order to form a moule of an animal or a plant capable of reproducing, it is necessary that Nature work material in three dimensions at once and that heat distribute the organic molecules in the same proportion, . . ."

[82] HN., 2: 45-46.

[83] Ibid., p. 45. "they are not the kinds of things we are able to perceive."

[84] Ibid. "at the same time it is no less certain that they exist."

denied every quality except those which we can directly observe or perceive. When philosophers admit only a limited number of mechanical principles they do not consider how much they constrict philosophy and how few phenomena can be explained by this method of thinking. From Buffon's point of view, then, the Cartesian philosophy, in spite of its clarity, is unable to explain the phenomena of life: the mechanical principles inherent in the Cartesian system are only modes of perception -- modes which could be incorrect. Different qualities would be recognized if our senses confirmed different data. Besides, Buffon stated, the causes of impulsion, cohesion, or any other mechanical principle are equally as inscrutable as that of attraction.[85]

Buffon on the Process of Generation

It has been shown, thus far, that for Buffon the growth and nutrition of all beings entail two basic processes: (1) the interpenetration of organic molecules into all parts of living bodies, and (2) the molding of these molecules into the configuration of each of the parts they penetrate. Now, the same living material that is used in these two universal processes also supplies the organic matter which is used in the reproductive process. The particular way in which this matter is provided in the formation of new individuals varies according to the complexity of the organism.

The entire body of the simplest of organisms, such as worms, polyps, elms, willows, several other plants, and insects constitutes

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[85] Ibid., pp. 50-52.

one moule intérieur. Consequently, all of their parts are organized in precisely the same manner. The uniformity in their bodily organization means that each part of their body can develop -- given the opportunity to take in and assimilate new organic molecules -- into new individuals structured exactly like the one from which it was taken. Reproduction amongst these creatures with one moule intérieur can occur, then, by the mere division of their bodies.[86]

There are other organisms, such as plant lice, which like the simplest living things are able to reproduce themselves through only one individual but which have several different parts acting each one as moules intérieurs. These parts, these moules, admit only those organic molecules which are characteristic to themselves.[87]

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[86] Ibid., pp. 18-19.

In 1740 Abraham Trembley (1700-1784) discovered a most curious and seemingly inexplicable phenomenon -- a phenomenon that startled and amazed most investigators of generation: the ability of a freshwater polyp after having been cut into two parts to grow into two complete animals. (See Shirley A. Roe, "The Development of Albrecht von Haller's Views on Embryology," Journal of the History of Biology 8 [1975]: 167-90. See also Aram Vartanian, "Trembley's Polyp, La Mettrie, and Eighteenth Century French Materialism," Journal of the History of Ideas 11 [1950]: 259-86.)

Leeuwenhoek had observed the polyp, but knowledge of the polyp's strange ability went relatively unnoticed. (See Antony van Leeuwenhoek, "Concerning Green Weeds Growing in Water, and Some Animalcula Found about them," Philosophical Transactions no. 283, 23 [January and February 1703]: 1304-1311.)

Buffon's belief that the least organized beings were organized uniformly throughout their bodies made it possible for him to explain the behavior of the polyps: one part of these beings is exactly like any other part, and each part may grow and develop like an individual creature if separated from its parent.

[87] Ibid., p. 54.

After the full growth of the organism, each of these parts sends to one or more places those organic molecules which beforehand would have been used for their growth. In the places where the excess organic molecules have gathered together one or more new organisms will be formed. These molecules are reassembled and reunited by a force similar to the one which penetrates all the different parts of living bodies. The new organisms will be totally similar to the parent individuals, because the parents send from each of their parts organic molecules that compose the analogous parts of the new individual.[88] That is, the new individual will have a moule intérieur like its parent's.

With the animals which are divided into two sexes, such as man, no individual by itself can produce an offspring: reproduction requires the combination of the corresponding organic molecules from each part of the male and the female. The parts of each individual, after they have almost completed their growth, start sending those organic molecules which they no longer need for growth into sexual organs destined to receive them. Within these sexual organs, the organic molecules form the seminal fluids. After copulation, the seminal fluids of the male and the seminal fluids of the female mix. The attractive penetrating force draws the molecules together; the molecules from the corresponding parts of the male and the female, having an affinity for one another, then coalesce into a small organized body resembling its parents.[89] If there are more male organic

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[88] Ibid., pp. 53-54.

[89] Ibid., pp. 55-64.

molecules in the mixture, male offspring are produced; if there are more female organic molecules, female offspring are produced.[90]

Thus the fact that the species consist of generations linked together through reproduction became a physical truth explained. The penetrating force working on certain kinds of brute matter produced the organic molecules, the penetrating force then produced the moules intérieurs of organisms. The perpetual infusion into the interior and exterior parts of the moules intérieurs via the penetrating force assures the continued existence of organisms. The perpetuation of the parents' organic form is assured through the replication of the moules intérieurs.

Still, Buffon admitted, there are questions which his theory of sexual reproduction cannot, in the final analysis, answer. The most important unanswerable question was the one which Aristotle had pointed out about the Hippocratic theory of sexual generation: what is the necessity of two sexes when each sex alone collects all the necessary organic matter needed to form an embryo? As Buffon himself asked:

> Pourquoi donc cet être organisé ne s'y forme-t-il pas, & que dans presque tous les animaux il faut que la liqueur qui contient ces molecules organiques, soit mêlée avec celle de l'autre sexe pour produire un animal?[91]

After all, as Buffon pointed out, in plants and some animals Nature

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[90] Ibid., p. 58.

[91] Ibid., pp. 332-33. "Why, therefore, is this organized being not formed, and that in almost all animals it is necessary that the liquid which contains these organic molecules be mixed with that of the other sex in order to produce animals?"

seems to have taken the easy way and allowed individuals to reproduce. Why complicate reproduction with two sexes? Why Nature does something, Buffon replied, cannot be answered, and therefore this question about sexual reproduction is not a legitimate scientific query; it is enough to know sexual generation does occur. At any rate, sexual reproduction must be easy for Nature.[92]

Even though Buffon was unable to explain why sexual reproduction occurs, he did proffer an explanation as to why the molecules from both parents are needed to form offspring. Buffon stated that the excess organic molecules in the unmixed male or female seminal fluids are in such a continual state of agitated activity that they cannot unite. They are continually returning to the parts of the body from which they came and to which they have a great analogy; these parts invariably repel these superfluous molecules from themselves, and thus these extra molecules circulate around and around, from part to seminal fluid back to part incessantly. This continual arrival and departure of organic molecules means that a new individual is never formed in the body of one organism. But after a mixture of male and female fluids has taken place, the motion or force of the molecules of one individual resists and counterbalances the motion or force of the other's organic molecules. This interference of one set of organic molecules with another creates a state of equilibrium and the molecules of both individuals are able to establish themselves

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[92] Ibid., pp. 82-83.

locally long enough for the formation of an animal.[93]

Buffon's theory of reproduction, which he believed explained the phenomena of life and gave meaning to his assertion that the species constitute the succession of similar individuals, remained purely hypothetical without empirical verification that the organic molecules -- or at least the first assemblages of them -- exist in the seminal fluids of females as well as males among those species which propagate sexually. In 1748, after he had already forged the major part of his theory of reproduction and claimed the existence of the organic molecules, Buffon conducted several experiments in which he purposefully searched for the organic molecules in various organic bodies and in the seminal fluids of the males and females of several different species. Of course he found them: he had to. In the seminal fluid -- or what he thought to be the seminal fluid -- taken from a live bitch in heat who had not copulated with a male Buffon found what he needed and sought:

> J'examinai donc cette liqueur au microscope, & du premier coup d'oeil j'eus la satisfaction d'y voir des corps mouvans avec des queues, qui étoient presqu' absolument semblables à ceux que je venois de voir dans la liqueur séminale du chien.[94]

In many other experiments the seminal fluids taken from all species of sexual animals were rife with moving particles. Also Buffon

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[93] Ibid., pp. 334-37.

[94] Ibid., p. 203. "I therefore examined this liquid with a microscope. With the first glance I had the satisfaction of seeing moving bodies with tails, which were almost absolutely similar to those which I have seen in the seminal liquid of the male dog."

claimed to have found similar living particles -- or simple organized beings -- in the material attached to teeth,[95] seeds of plants, and the bodies of animals.[96] Thus the existence of the organic molecules was not probable but certain.[97]

All forms of false theories, but in particular the theory of pre-existence, seemed to Buffon to be destroyed; and in his eyes his theory never seemed to have so much veracity: he had empirical verification of the organic molecules, he had seen various proofs that organic molecules seek organization, and he had shown that the seminal matter of females contain organic particles. Thus, Buffon could write, with an air of finality, in reflecting upon his experiments with the seminal fluids of animals, the following:

> Tous les animaux, mâles ou femelles, tous ceux qui sont pourvûs des deux sexes ou qui en sont privés, tous les végétaux, de quelques espèces qu'ils soient, tous les corps en un mot, vivans ou végétans, sont donc composés de parties organiques vivantes qu'on peut démontrer aux yeux de tout le monde; ces parties organiques sont en plus grande quantité dans les liqueurs séminales des animaux, dans les germes des amandes des fruits, dans les graines, dans les parties les plus substantielles de l'animal ou du végétal, & c'est de réunion de ces parties organiques, renvoyées de toutes les parties du corps de l'animal ou du végétal, que se fait la reproduction, toujoûrs semblable à l'animal ou au végétal dans lequel elle s'opère, parce que la réunion de ces parties organiques ne peut se faire qu'au moyen du moule intérieur, c'est-à-dire, dans l'ordre que produit la forme du corps de l'animal ou du végétal, & c'est en quoi consiste l'essence de l'unité & de la continuite des espèces, qui dès-lors ne doivent jamais s'épuiser, & qui d'elles-mêmes dureront autant qu'il plaira à celui qui les a créées de les

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[95] Ibid., p. 282.

[96] Ibid., pp. 284-99.

[97] Ibid., p. 426.

laisser subsister.[98]

Surveying Buffon's theory of generation, it is evident that the moule intérieur is responsible for the organic continuity within each species; therefore, it is the moule intérieur which makes sense of Buffon's conviction that the species are the ever continuous renewal of similar individuals. The organic material released -- or separated in the case of the most simple beings -- which is used in the production of offspring is formed into a moule intérieur essentially like its parent's. The form of the offspring, thus, is literally provided to it by the parents.[99] The moule intérieur, then, determines the boundaries in the living realm and explains the organic intervals between the species.

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[98]Ibid., p. 258. "All animals, male or female, all those who are provided with two sexes or which are deprived of them, all plants, of whatever species they be, all the bodies, in a word, living or vegetating, are, then, composed of living organic parts -- parts which can be demonstrated to the eyes of everyone. These organic parts are in greatest quantity in the seminal liquids of animals, in the germs of the amandes of fruits, in seeds, in the most substantial parts of the animal or the plant; and it is the reunion of the organic parts, discharged from all the parts of the body of the animal or the plant, which causes always a reproduction similar to the animal or to the plant in which they are operating -- because the reunion of these organic parts can only be made by means of the moule intérieur, that is to say, in the order that the form of the animal or plant body produces, and it is in this that consists the essence of the unity and of the continuity of the species, which from then on can never be exhausted, and which of themselves will endure so long as it is pleasing to the one who had created and allowed them to subsist."

[99]HN., 14: 26.

CHAPTER V

BUFFON'S THEORY OF ORGANIC ALTERATION

1753-1764

In the last chapter it was shown how Buffon argued that generation after generation it is the moule intérieur which fixes an eternal and constant form on every member of each species. But in the articles on domestic and wild animals, which he commenced writing in 1753, Buffon confronted the possibility that certain species have undergone seemingly fundamental organic alterations and that all species contain markedly different kinds of creatures.

And yet he was unwilling and unable to reject the idea of the moule intérieur as the single, unchanging, essential characteristic of every member of every species. To have rejected his idea of the moule intérieur would have meant the undermining of his theory of generation, the elimination of his idea of the species, and the destruction of his entire view of the order and structure of living Nature.

Buffon achieved a kind of reconciliation between his insistence upon the fixity of organic forms and his acknowledgment that

pervasive and unrelenting environmental influences can in time create drastic differences between groups within the species. He developed a doctrine which accorded Nature her diversity but which allowed him to retain his theory of reproduction and his concept of the moule intérieur.

The primary purpose of this chapter is to discuss how Buffon eventually reconciled the idea of the moule intérieur with his realization that extensive alterations do occur in the organic world. In order to do that one must examine all of the many articles published between 1753 and the 1780's. The works which appeared between 1753 and 1766 are particularly important. By 1766 Buffon had, to a large degree, worked out in final form the function of the moule intérieur and the causes and the extent of organic change within the living world.

In his article on the horse (1753), the first essay concerned with the quadrupeds, Buffon made his initial attempt to reconcile the idea of a timeless organic form sustained by the moule intérieur with that of organic degeneration and change. Buffon stated that the first animals have served as models and as moules intérieurs, that is, as prototypes, for future generations of their kind; and although the original imprint of these prototypes is constant and subsists in its entirety in each generation, the prototypes do not remain unchanged throughout time:

> Il y a dans la Nature un prototype général dans chaque espèce sur lequel chaque individu est modelé, mais qui semble, en se réalisant, s'altérer ou se perfectionner par les circonstances; en sorte que relativement à de certaines qualités, il y a une variation bizarre en apparence dans la succession des individus,

> & en même temps une constance qui paroît admirable dans l'espèce entière: le premier animal, le premier cheval, par exemple, a été le modèle extérieur & le moule intérieur sur lequel tous les chevaux qui sont nés, tous ceux qui existent & tous ceux qui naîtront ont été formés; mais ce modèle dont nous ne connoissons que les copies, a pû s'altérer ou se perfectionner en communiquant sa forme & se multipliant, l'empreinte originaire subsiste en son entier dans chaque individu; mais quoiqu'il y en ait des millions, aucun de ces individus, n'est cependant semblable en tout à un autre individu, ni par conséquent au modèle dont il porte l'empreinte: . . .[1]

In response to changes in their external conditions, variations can be general and accumulative in organisms. These environmental changes, although never extinguishing the expression of the imprint in successive generations, in time appreciably alter the form of creatures. Very little alteration takes place in animals of the first generation, because they have been formed before being isolated in an alien environment. The new conditions may alter their temperament, but it has little influence on the organic parts, which have already taken solid form. The organic form of these first generation animals is especially fixed if they have reached their full growth.

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[1] HN., 4: 215-16. "There is in Nature a general prototype in each species upon which each individual is patterned, but which seems in manifesting itself to be altered or improved by the circumstances. Hence, relative to certain qualities, there is a peculiar variation in appearance in the succession of individuals; and yet at the same time there appears an admirable constancy in the species as a whole. The first animal, the first horse, for example, has been the exterior model and the moule intérieur upon which all horses that have been born, all that exist, and all that will be born have been formed. But this model, of which we know only copies, has been able to alter or improve itself in communicating its form and in multiplying itself. The original imprint subsists in its entirety in each individual; and although millions have existed, none of these individuals is, however, exactly like any other, nor consequently, totally like the model whose imprint it bears: . . ."

The imprint in these animals remains pure. Having been exposed to the new environment long before their full formation and growth, the individuals of the second generation will exhibit perceptible changes in their form. They will pass their defects on to their offspring, whose form will also be altered by the conditions which changed their parents' form, and so on for each succeeding generation. Each generation, then, possesses the alterations passed to them by their parents plus any additional ones caused by their environment.[2]

Although Buffon made it perfectly clear in the essay on the horse that the alteration of organisms can never produce new species, at least one scholar has suggested that the remarks he made in an essay on the ass, also published in 1753, are indications that he did not truly believe, even at this early date, in the fixity of organic forms.[3] Buffon did suggest, at the very outset of the essay, that since the horse and the ass have similar anatomical features, the ass might be considered a degenerate horse.[4] But the suggestion that the ass issued from the horse was soon shown to be impossible, and it did not take him long to disavow any claims to an evolutionary thesis. The fact that creatures of different species are similar in appearance does not necessarily mean that they are organically related, although it does point out that "la Nature se fasse par nuances & par degrés, souvent

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[2] Ibid., pp. 217-18.

[3] Butler, Evolution, Old and New, pp. 86-91.

[4] HN., 4: 377-78.

imperceptibles, . . ."[5] It is neither "le nombre ni la collection des individus semblables qui fait l'espèce, . . ."[6] Species is an abstract and general term to which a corresponding thing exists only in considering Nature in the succession of time, and in the constant destruction and renewal of beings.[7] Species is thus only a "succession constante d'individus semblables & qui se reproduisent, . . ."[8] Hence, no matter that the ass and horse resemble one another more than a water-spaniel resembles a greyhound, the greyhound and the water-spaniel belong to the same species, because they are reproductively compatible, whereas the ass and the horse do not belong to the same species, since they "ne produisent ensemble que des individus viciés & inféconds."[9] "L'âne est donc un âne, & n'est point un cheval dégénéré, un cheval à queue nue; il n'est, ni étranger, ni intrus, ni bâtard; il a, comme tous les autres animaux, sa famille, son espèce & son rang; . . ."[10]

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[5]Ibid., p. 383. "Nature is made by nuances and degrees, which are often imperceptible, . . ."

[6]Ibid., p. 384. "the number nor the collection of similar individuals which makes the species, . . ."

[7]Ibid., pp. 384-85.

[8]Ibid., p. 386. "constant succession of similar individuals which reproduce, . . ."

[9]Ibid., p. 385. "produce together only vitiated and infertile individuals."

[10]Ibid., p. 391. "The ass is therefore an ass and not a degenerate horse, a horse with a bare tail. It is neither foreign, nor an intruder, nor a mongrel. It has, as all other animals, its family, its species, and its rank; . . ."

Degeneration, in Buffon's eyes is a deterioration of the pristine organic form of a species and thus cannot lead to a positive creation. How, then, Buffon asked, can it be supposed that degenerate creatures, which are impure and vitiated, can "non seulement produire une succession d'êtres constans, mais même les produire de la même façon & suivant les même loix que se reproduisent en effet les animaux dont l'origine est pure?"[11] Degeneration only alters individuals and does not interfere with the laws inherent in the processes of reproduction; therefore, degeneration cannot fundamentally alter the species nor obliterate the organic separation between them.

In the context of Buffon's theory of reproduction and his concept of the moule intérieur his eloquent statement that the horse and the ass are each different species, then, makes perfect sense: they have similar but different moules intérieurs; consequently, any offspring produced from the copulation of an ass with a horse are aberrations -- unnatural occurances with no chance of producing progeny.

While degeneration cannot transform the species, that is, fundamentally alter the form of the species, it can weaken the ability of individuals in an inimical environment to develop fully the characteristics intrinsic to their species. Each degree of degeneration visited upon living things is a degree which further vitiates them mentally and physically. The result of extreme degeneration is the

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[11] Ibid., p. 390. "not only produce a succession of constant beings, but even produce them in the same way and following the same laws as are involved in the reproduction of animals of pure origin?"

production of inferior forms of life which seem to stand apart from the least degenerate members of the same species. For example, Buffon thought that the Hottentots are so degenerate that they are close in their anatomical structure and physical features to apes.[12] They are, however, human beings by virtue of the fact that they can think, they have a soul, and they make use of a language.[13]

Although degeneration was considered by Buffon to be the most common form of organic alteration, he at times spoke of the improvement of animals. By improvement Buffon usually meant regeneration: degenerate animals will tend to regain the organic form of their first ancestors if removed to a climate favorable to them. For example, Negroes will slowly become white if transplanted into a temperate climate.[14] But Buffon seemed to believe that at times animals literally improved. In the "Degeneration of Animals" (1766) he wrote that certain New World animals, the North American foaldeer and roedeer, for example, are stronger and larger than their kin -- from which they descended -- in the Old World.[15]

Alterations result from the fact that the organic molecules taken into the body in the form of nourishment, although homogeneous, are not totally without influence upon the moule intérieur which ingests them. In the essay on the stag (1756), Buffon, first stating

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[12] HN., 14: 30-32.

[13] Ibid., p. 32.

[14] HN., 3: 523-24.

[15] HN., 14: 329-30.

that the organic molecules can never dominate the moule intérieur, since it is the moule intérieur which shapes the organic molecules to the form of the living thing, then stated that the organic molecules are not always assimilated perfectly into the moule intérieur.[16] This organic matter

> n'est pas absolument dépouillé de la forme qu'elle avoit auparavant, & elle retient quelques caractères de l'empreinte de son premier état; elle agit donc elle même par sa propre forme sur celle du corps organisé qu'elle nourrit; . . .[17]

Thus,

> Le cerf, qui n'habite que les forêts, & qui ne vit, pour ainsi dire, que de bois, porte une espèce de bois, qui n'est qu'un résidu de cette nourriture: le castor, qui habite les eaux, & qui se nourrit de poisson, porte une queue couverte d'écailles: la chair de la loutre & de la pluspart des oiseaux de rivière est un aliment de carême, une espèce de chair de poisson.[18]

Since organic molecules can influence a living thing's moule intérieur, organisms which ingest organic molecules indigenous to an environment unlike their native environment will be appreciably altered. For example, finding themselves in colder climates in which organic molecules -- and thus plants and animals -- are smaller and less vigorous, organisms from hot climates become smaller and

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[16] HN., 6: 86-88.

[17] Ibid., p. 88. "is not absolutely stripped of the form which it had previously, and it retains some characteristics of the imprint of its first state; it acts therefore itself by its own form on the form of the organized bodies which it nourishes; . . ."

[18] Ibid., p. 88. "The stag, who lives only in forests and, so to speak, only eats wood, carries a kind of wood [antlers], which is only a residue of this nourishment. The beaver, who lives in water and who feeds on fish, carries a tail covered with scales. The flesh of otter and several waterfoal is an aliment of Lent, a kind of fishy flesh."

less vigorous. They

> ont donc dégénéré, si leur nature étoit la férocité jointe a la cruauté, ou plutôt ils n'ont qu'éprouvé l'influence du climat: sous un ciel plus doux, leur naturel s'est adouci, ce qu'ils avoient d'excessif s'est tempéré, & par les chamemens qu'ils ont subis ils sont seulement devenus plus conformes à la terre qu'ils ont habitée.[19]

Upon the belief that organisms are products of and conform to their climates, Buffon argued in 1761 that while the Old World is, for the most part, more favorable to the superior forms of life, climatic conditions in the New World make it more favorable to the inferior forms of life. The abundance of forests, lakes and rivers, and the overall high elevation keep most areas in the New World cold and damp.[20] "La Nature vivante y est donc beaucoup moins agissante, beaucoup moins variée, & nous pouvons même dire beaucoup moins forte; . . ."[21] It is not surprising that reptiles and insects thrive in the New World:

> . . . les insectes, les reptiles & toutes les espèces d'animaux qui se traînent dans la sange, dont le sang est de l'eau, & qui pullulent par la pourriture, sont plus nombreuses & plus grandes dans toutes les terres basses, humides & marécageuses de ce nouveau continent.[22]

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[19] Ibid., pp. 57-58. "have therefore degenerated, if their nature was a combination of ferocity and cruelty -- or rather they have only experienced the influence of the climate: under a softer sky their nature is softened. What was excessive about them is tempered. By these changes to which they have been subjected, they have only become more conformed to the territory which they inhabit."

[20] HN., 9: 106-8.

[21] Ibid., p. 87. "Living Nature is therefore much less active, much less varied there, and we can even say less strong; . . ."

[22] Ibid., p. 111. ". . . insects, reptiles and all the species which are dragging through the mud, whose blood is water, and which rapidly multiply through corruption are more numerous and larger in all the low, humid, and marshy places of this new continent."

Nor is it surprising that the New World quadrupeds are much smaller than those of the Old World:

> . . . les animaux y sont incomparablement plus petits que ceux de l'ancien continent, & qu'il n'y en a aucun en Amérique qu'on puisse comparer a l'éléphant, au rhinoceros, à l'hippopotame, au dromadaire, à la giraffe, au buffle, au lion, au tigre, &c.[23]

Further proof of the comparatively poor environmental conditions in the New World for the growth and preservation of the quadrupeds is the fact that, as Buffon saw it, every domesticated quadruped brought from the Old World into the New World had degenerated into a smaller, weaker, less vigorous kind of an animal. Buffon said, for example, not only horses but also "les boeufs, les chèvres, les moutons, les cochons, les chiens, sont plus petits en Canada qu'en France; . . ."[24]

In the articles on animals common to both continents (1761), Buffon stated that not only domesticated animals have been altered in the New World but wild ones have as well.[25] As a matter of fact, Buffon went so far as to suggest that the New World species, whose ancestors came from the Old World, have been altered under new climatic conditions so drastically that they have become separate species. He wrote:

> Il ne seroit donc pas impossible, que, même sans intervertir

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[23] Ibid., p. 87. ". . . animals there are incomparably smaller than those of the old continent, and there are none in America which one can compare with the elephant, with the rhinoceros, the hippopotamus, the dromedary, the giraffe, the buffalo, the lion, the tiger, etc."

[24] Ibid., p. 72. "cattle, goats, sheep, pigs, dogs are smaller in Canada than in France; . . ."

[25] Ibid., p. 127.

> l'ordre de la Nature, tous ces animaux du nouveau monde ne fussent dans le fond les mêmes que ceux de l'ancien, desquels ils auroient autrefois tiré leur origine; on pourroit dire qu'en ayant été séparés dans la suite par des mers immenses ou par des terres impraticables, ils auront avec le temps reçû toutes les impressions, subi tous les effets d'un climat devenu nouveau lui-même & qui auroit aussi changé de qualité par les causes mêmes qui ont produit la séparation; que par conséquent ils se seront avec le temps rapetissés, dénaturés, &c. Mais cela ne doit pas nous empêcher de les regarder aujourd'hui comme des animaux d'espèces différentes: . . .[26]

Buffon did not, in the article on the animals common to both continents, elaborate upon his suggestion that degeneration can lead to the appearance of new species. Someone searching for Buffon's first important move toward an evolutionary thesis might find that strange. He had, after all, argued mightily against such a thesis in the article on the ass (1753), and one would think that such a reversal of his basic view of Nature might have brought forth some sort of explanation. Was he, as Butler might have suggested, simply trying to slip something by the Sorbonne? Was he bold in his concepts but timid in his character, as Clodd intimated? The fact is, as will be shown directly, Buffon was not on the verge of changing fundamentally any of his basic beliefs in 1761.

Even though in 1761 he tentatively broached the idea that

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[26] Ibid., p. 127. "Even without transposing the order of Nature, it is not impossible, therefore, that all these animals of the New World are in essence the same as those of the Old [World] from whom they originated. Further, one could suggest, that having been subsequently separated by immense seas or by impassable land, and with time having received all the impressions and undergone all the effects of the climate, which itself has been changed by the very causes which produced the separation, these animals with time have shrunk, have become perverted, etc. But this should not hinder us from regarding them at present as animals of different species: . . ."

natural alteration could cause the appearance of new species, as late as 1764, in an essay entitled "Le Mouflon et les autres brebis," Buffon still asserted that natural genera are metaphysical and arbitrary mental constructs which have no existence. He was willing, however, to admit that genera can be induced through the manipulation of man:

> . . . il nous a paru nécessaire, en composant l'histoire des animaux sauvages, de les considérer en eux-même un à un & indépendamment d'aucun genre; autant croyons-nous, au contraire, qu'il faut adopter, étendre les genres dans les animaux domestiques, & cela parce que dans la Nature, il n'existe que des individus & des suites d'individus, c'est-à-dire des espèces; que nous n'avons pas influé sur celles des animaux indépendans, & qu'au contraire nous avons altéré, modifié, changé celles des animaux domestiques: nous avons donc fait des genres physiques & réels, bien différens de ces genres métaphysiques & arbitraires, qui n'ont jamais existé qu'en idée; ces genres physiques sont réellement composés de toutes les espèces que nous avons maniées, modifiées & changées; & comme toutes ces espèces différemment altérées par la main de l'homme, n'ont cependant qu'une origine commune & unique dans la Nature, le genre entier ne doit former qu'une espèce.[27]

It should be noted here that Buffon identified these genera in the same manner that he had earlier, in 1753, identified the species: they are groups of animals which are able to successfully

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[27] HN., 11: 369. ". . . it appears necessary in composing the history of the wild animals to consider them one by one independently of genera. Much to the contrary, it is necessary to adopt and expect genera in domestic animals. And this is because in Nature there only exists individuals and the succession of individuals, that is to say, species. We have no influence upon species of those independent animals, but to the contrary we have altered, modified, and changed species of domestic animals. We have created physical and real genera, very different from the metaphysical and arbitrary genera, which are nothing more than an idea. These physical genera really consist of all the species which we have managed, modified, and changed; and, as all these differently altered species by the hand of man have, however, only one common and unique origin in Nature, the entire genus must form only a single species."

interbreed among themselves or with the souche premier, that is, with the animal which represents the prototype of their kind. When Buffon stated that the entire genus must only form one species he was referring to the fact that the kinds of animals within genera are capable of interbreeding.[28] In other words, these separate species within a particular genus all have a similar enough moule intérieur to produce fertile offspring with one another.

Buffon did not, then, in "Le Mouflon," change his definition of the basic organic units. Once again, rejecting a belief in what he thought to be the arbitrary genera of the systematists, Buffon stated that man can create separate varieties (now called species) which constitute genera; however, since the varieties are capable of interbreeding with one another, they are not so many organically distinct types of animals subsumed within abstract genera. Buffon still believed, of course, that there must exist a real, physical relationship between the members of each different organic unit. Thus, in his mind, the definition of the basic units within the living realm remained the same: a constant succession of similar individuals through reproduction.

First and Second Views of Nature

After positing the existence of man-made genera, Buffon felt compelled to explain in two broad philosophical articles -- one in 1764 and one in 1765 -- that although individuals and groups of individuals change, there are no essential alterations within the living

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[28] Ibid., pp. 363-70.

realm. In Buffon's mind the imprints of each species are synonymous with the timeless structure of the universe; they are beyond change and corruption.

In his first "Vue de la Nature," Buffon made it clear that he believed there was an immutable, timeless structure behind the flux of natural phenomena. With literary flourish he stated that "la Nature est elle-même un ouvrage perpétuellement vivant, un ouvrier sans cesse actif, qui sait tout employer, . . ."[29] Nonetheless

> elle n'altère rien aux plans qui lui ont été tracés, & dans tous ses ouvrages elle présente le sceau de l'Éternel: cette empreinte divine, prototipe inaltérable des existences, est le modèle sur lequel elle opère, modèle dont tous les traits sont exprimés en caractères ineffaçables, & prononcés pour jamais; modèle toujours neuf, que le nombre des moules ou des copies, quelqu'infini qu'il soit, ne fait que renouveler.[30]

The structure of Nature -- which is the system of laws established by God[31] -- never changes and is timeless; only the copies, that is, the outward manifestations, which are the phenomena of our experience, are forever new.[32]

In the second "Vue de la Nature," Buffon identified the

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[29]HN., 12: iii. "Nature is itself a perpetually living work, a ceaselessly active worker, which knows how to use everything, . . ."

[30]Ibid., p. iv. "it alters nothing in regard to the plans which have been traced in it, and in all its works it presents the stamp of the Eternal. This divine imprint, this unalterable prototype of existences is the model on which it operates -- a model whose traits are imprinted in ineffaceable characters pronounced forever. It is an ever new model, whose number of molds or copies, as infinite as they are, can only renew."

[31]Ibid., p. iii.

[32]Ibid., p. iv.

imprint of each species with the unalterable structure of the laws of the universe. It is here that the perpetuity of the species is for the first time explicitly stated to be determined by the immutable constancy of the laws of Nature. "L'empreinte de chaque espèce est un type dont les principaux traits sont gravés en caractères ineffaçables & permanens à jamais; . . .,"[33] Buffon proclaimed. And a man viewing Nature's past, present, and future as a whole will

> trouve les espèces constantes, la Nature invariable: la relation des choses étant toujours la même, l'ordre des temps lui paroît nul; les loix du renouvellement ne font que compenser à ses yeux celles de la permanence; une succession continuelle d'êtres, tous semblables entre eux, n'équivant, en effet, qu'à l'existence perpétuelle d'un seul de ces êtres.[34]

No longer merely a succession of like individuals, the species are a whole, independent of time and fleeting individuals:

> Un individu, de quelque espèce qu'il soit, n'est rien dans l'Univers; cent individus, mille ne sont encore rien: les espèces sont les seuls êtres de la Nature; êtres perpétuels, aussi anciens, aussi permanens qu'elle; que pour mieux juger nous ne considérons plus comme une collection ou une suite d'individus semblables; mais comme un tout indépendant du nombre, indepéndant du temps; un tout toujours vivant, toujours le même; un tout qui a été compté pour un dans les ouvrages de la création, & qui par conséquent ne fait qu'une unité dans la Nature.[35]

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[33] HN., 13: ix. "The imprint of each species is a type whose principal traits are engraved in ineffacable and permanent characters forever, . . ."

[34] Ibid., p. iv. "find species constant and Nature invariable. The relation of things being always the same, the order of time will appear to him nonexistent; the laws of renewal only counterbalance, in his view, those of permanence: a continual succession of beings all similar, only being equivalent, in fact, to the perpetual existence of only one of these beings."

[35] Ibid., p. i. "An individual, no matter the species to which it belongs, is nothing in the Universe. A hundred, a thousand are still nothing. Species are the only beings in Nature; they are perpetual beings, as old, as permanent as Nature herself. In order to

Buffon's assertion in the two "Vues" that the species are independent from individuals seems to be a shift away from his position that species are nothing more than the succession of similar individuals which reproduce. But rather than changing his mind about the reproductive continuity of each species -- which is, after all, empirical proof that species exist -- Buffon has here placed greater emphasis upon that which insures the organic similarity from generation to generation in all the individuals of each species; he has emphasized the imprint, which is never effaced, irrespective of the alteration of any particular individual or any group of individuals, of the eternal species.

1766 and After

After having clearly stated that the imprint of each species is permanent and cannot change, Buffon declared in 1766 that Nature and not man alone can produce genera. Finding that not all hybrids are infertile -- which proved to him that certain distinct but neighboring species must have compatible moules intérieurs and must have thus stemmed from the same source -- Buffon announced that degeneration can produce new species and that natural genera do exist:

> Mais après le coup d'oeil que l'on vient de jeter sur ces variétés qui nous indiquent les altérations particulières de chaque espèce, il se présente une considération plus importante & dont la vue est bien plus étendue; c'est celle du changement

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judge better for ourselves, we will no longer consider a species as a collection or a continuation of similar individuals, but as one living whole, independent of number, independent of time; an always living whole, which is always the same; a whole, which has been reckoned one in the works of creation, and consequently constitutes only one unit in Nature."

> des espèces mêmes, c'est cette dégénération plus ancienne & de tout temps immémoriale, qui paroît s'être faite dans chaque famille, ou si l'on veut, dans chacun des genres sous lesquels on peut comprendre les espèces voisines & peu différentes entr'elles: . . .[36]

Has Buffon just refuted everything he has written up to this point and declared that degeneration can result in the transmutation of the species? He has not. For Buffon to have suddenly announced in favor of a theory of transmutation would have run directly counter to his deep conviction, which he had expressed just one year before (1765), that the principal traits of each imprint of every species are eternal. No manner of alteration upon individuals or groups of individuals can efface the imprint of the species.

To understand that Buffon has not basically changed his belief that alterations are limited within boundaries set by the moules intérieurs, it is necessary to look more closely at how he used the terms family and genus in 1766. A genus, or family (they meant the same thing), contains all of the distinct, separate, and constant varieties (species now) which have in common certain fundamental characteristics and which all stem from the same organic form, or, as Buffon called it, the same souche ou le tronc principal, that is, the group representing the original species. Thus, horses (the

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[36]HN., 14: 335. "But after the quick review just given to these varieties, which indicate the particular alterations of each species, a more important consideration with far reaching consequences presents itself. It is that of the changing of the species themselves. It is this degeneration, most old and from time immemorial, which appears to have been made in each family, or, if you will, in each of the genera, under which we can understand the neighboring and slightly differing species: . . ."

souche principal), asses, zebras (the two natural collateral branch species) and mules constitute one family (genus).[37] Certain other groups of animals, which Buffon called isolated species, have only direct line descendants; they have no collateral branches. These isolated species, then, "forment des genres ou des espèces simples qui ne se propagent qu'en ligne directe & n'ont aucunes branches collatérales; . . ."[38] But in either genera with collateral branches or genera with only direct lines, Buffon, as he had stated earlier in regard to the genera created by man, stated that the entire genus forms only one species.[39] Any member of a genus, thus, is capable of reproducing with any other member; a horse can and does produce fertile offspring when mated to an ass and probably could produce a fertile offspring if mated to a zebra.[40] Horses, asses, and zebras must therefore have reproductively compatible moules intérieurs. Genus, then, is a term used to refer to the separate groups of species linked together by common descent and reproductively compatible moules intérieurs. This is precisely how Buffon linked together the various members of a species (now genus) in 1753. The point is, Buffon's basic belief that there are distinct groups of animals separated by their respective moules intérieurs did not change from 1753 to 1766. In 1766 he

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[37] Ibid.

[38] Ibid. "form genera or simple species which only propagate in a direct line and have no collateral branches: . . ."

[39] Supra., p. 90.

[40] HN., 14: 336.

grouped together species which in 1753 he thought were truly separate, that is, reproductively incompatible; but the genera-species, as species were in 1753, are still defined as the succession of similar individuals which reproduce (or are capable or reproducing) themselves.

Buffon's use of natural genera allowed him to divide two hundred separate species of quadrupeds and apes into twenty-five genera and thirteen isolated species.[41] This method of classification fit well with his belief in a hierarchy of being and the fixity of organisms: the highest, most elevated, and constant forms of life, such as man, are the isolated species, whose forms living conditions and time have varied very little; the genera containing various and different species constitute the lesser forms of life which are, to a greater or lesser degree, subject to degradation and degeneration. The less the number of species (constant varieties) within a genus, the more elevated the form of life. Thus, the genus solipedes, which includes horses, asses, mules, and zebras, is a more elevated form of life than the genus of the animals with nonretractile claws, which includes foxes, dogs, wolves, jackals, and isatis.

Buffon's acceptance of natural genera also made his history of the birds a tolerable undertaking. As he turned his attention to writing a history of birds in the early 1770's, Buffon was overwhelmed with a plethora of species and races, and the description of each species of the birds individually, as he had done with the quadrupeds, seemed a nearly impossible task. What he did instead was to use one

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[41] Ibid., pp. 358-74.

species as a model for comparison with all other species belonging to the same genus.[42] This made it possible for him to avoid describing each time all the characteristics of each of the many species. The description of the model served as a general description of all the species of the same genus. All Buffon had to do, after describing the model species, was to then point out the remaining ways in which the other species of a particular genus differ with the model species.

The acceptance of natural genera, far from indicating that Buffon had abruptly become a transmutationist, then, actually allowed him to reconcile the existence of great variations within the basic groups of animals with the idea of the moule intérieur and his theory of reproduction. The use of genera also made palatable certain errant phenomena of the organic world -- phenomena which had become bothersome, if not anomalous. Hybrids no longer appeared as aberrations -- unnatural monsters. They are the natural but vitiated offspring of two different but reproductively compatible species, that is, species who share a similar moule intérieur and have a common organic source. The genera produced by domestication no longer represent perversions of Nature: they are species, although created by man, within genera -- genera which include their wild cousins. And New World animals which are similar to Old World animals are degenerate forms of the same genus.

By the 1770's all phenomena of the living realm were being drawn ever tighter into a conceptual framework in which great

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[42] HNO., 4: 517-18.

diversity among the living creatures was made compatible with the idea of unchanging and timeless forms of life. There still were, however, certain phenomena that at first glance appeared inexplicable. The facts of the earth's past seemed to indicate that a great number of forms of life had disappeared without leaving any descendants. Perhaps, as Buffon had wondered in 1761, particularly among the inferior species, the processes of degeneration have erased whole groups of plants and animals, changing them into different species or obliterating them altogether.[43] While the formation of new species was not unacceptable, the obliteration of the fundamental organic units seemed contradictory to the idea that the imprints of species endure forever. Perhaps the truth is found in the earth's past. One of Buffon's major goals after the synthesis drawn in 1766, as he stated in "Degeneration," was the study of the history of the earth.[44] The result of his project was the famous "Époques de la Nature" (1778).

In the "Époques" Buffon divided the history of the earth into seven major epochs. Each major epoch in the long history of the earth has been accompanied by great geological and/or organic developments. In the first epoch the earth was probably formed, Buffon hypothesized, when a passing comet tore a massive chunk of matter from the sun.[45] The second epoch saw the slow cooling of the earth's surface

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[43] HN., 9: 126-27.

[44] HN., 14: 374.

[45] HNS., 5: 40-70.

and the formation of the largest mountains and valleys.[46] During the third epoch great seas appeared and relatively primitive forms of animals appeared.[47] During the fourth epoch the water receded and the earth, particularly near the sea, was convulsed by volcanos.[48] It was about 15,000 years ago, during the fifth epoch, that the first great terrestrial animals, such as the giant elephants, appeared. The formation of these behemoths, Buffon believed, took shape in northern Siberia, which at that time was as warm as the equatorial areas (the torrid zones) are today.[49] The sixth epoch saw the separation of land masses, the most important being the separation of North America from northern Asia.[50] It was important because the animals, such as the mammoth elephants and rhinoceroses, which had emigrated to America from Asia, were isolated in North America. In America they met their deaths. Unlike their Old World cousins, which migrated to the southern parts of the Old World, the New World elephants and rhinoceroses, for example, could not traverse the American land mass from north to south as the world cooled, their path being blocked by a large mountain range near the isthmus of Panama.[51] They were stuck in the northern regions of America, and when the north became

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[46] Ibid., pp. 71-92.

[47] Ibid., pp. 93-130.

[48] Ibid., pp. 131-64.

[49] Ibid., pp. 165-90.

[50] Ibid., pp. 191-224.

[51] Ibid., pp. 174-76.

too cold these creatures, which require a hot climate in order to survive, perished.

The New World elephants died, but the Old World elephants -- or rather their descendants -- continued to live. The form of the elephant has endured, as have the forms of all the present-day creatures. The modern animals, it is true, are smaller in size than their ancient ancestors, but they are of the same origin.[52] It is, of course, the moules intérieurs which have conserved the organic form of these animals:

> Lorsque l'on compare ces anciens monumens du premier âge de la Nature vivante avec ses productions actuelles, on voit évidemment que la forme constitutive de chaque animal s'est conservée la même & sans altération dans ses principales parties: le type de chaque espèce n'a point changé; le moule intérieur a conservé sa forme & n'a point varié. Quelque longue qu'on voulût imaginer la succession des temps; quelque nombre de générations qu'on admette ou qu'on suppose, les individus de chaque genre représentent aujourd'hui les formes de ceux des premiers siècles, surtout dans les espèces majeures, dont l'empreinte est plus ferme & la nature plus fixe; . . .[53]

The ancient fossils prove, then, as Buffon saw it, that the moules intérieurs have conserved the form of each of the present-day species throughout the earth's history. The order and permanency of

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[52] Ibid., p. 27.

[53] Ibid., pp. 26-27. "When one compares these historical monuments of the initial age of living Nature with its present productions, one clearly sees that the constituent form of each animal is conserved the same and without alteration in its principal parts. The type of each species has not changed; the moule intérieur has conserved its form, and it has not varied. However long one wants to imagine the succession of time, whatever the number of generations that one admits or supposes, the individuals of each genus represent today the forms of those of the first centuries, especially in the major species, whose imprint is firmer and nature more fixed: . . ."

the organic world has manifested itself in the perpetual renewal of these living forms, or, as Buffon said, in the constant succession of similar individuals. Buffon has now, finally, in 1778, shown that the alteration of individuals or groups of individuals throughout the earth's long history, no matter the circumstances and no matter the time involved, does not fundamentally change the order and structure in the living domain.

But the eternity of the moules intérieurs was even more completely assured when Buffon removed them entirely from the vicissitudes of the earth's history. Buffon argued that given the proper physico-chemical conditions Nature would produce the same kinds of plants and animals anywhere in the universe. He wrote:

> . . . dans tous les lieux où la température est la même, on trouve nonseulement les mêmes espèces de plantes, les mêmes espèces d'insectes, les mêmes espèces de reptiles sans les y avoir portées, mais aussi les mêmes espèces de poissons, les mêmes espèces de quadrupèdes, les mêmes espèces d'oiseaux sans qu'ils y soient alles; . . .[54]

The moules intérieurs are, then, universal types of organic organization, which will appear each time the proper physical conditions exist. Thus, as one scholar has put it, "Le type animal, l'espèce au sens large du mot, fait partie de l'ordre éternel et est immuable comme lui."[55] However, just because they are eternal and immutable,

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[54]HNS., 2: 509. ". . . in all places where the temperature is the same one finds not only the same species of plants, the same species of insects, the same species of reptiles, without their having been brought there, but also the same species of fish, the same species of quadrupeds, the same species of birds without their having gone there; . . ."

[55]Roger, Les sciences de la vie, p. 581. "The animal type, the species in the large sense of the word, becomes a part of the eternal order and, like it, is immutable."

these moules intérieurs do not exist beyond the physical universe and should not be equated with anything like Platonic forms; they are, rather, universal effects of the laws of Nature.

To be sure, there have been species which have not been able to sustain themselves on earth. Nature, since she attempts all different combinations, has formed living things which have been unable to perpetuate their kind. These "monstres par défaut, ces ébauches imparfaites mille fois projetées, executées par la Nature, qui ayant à peine la faculté d'exister, n'ont dû subsister qu'un temps, . . ."[56] Also, some species, which were formed when the surface of the earth was much hotter than it is now, were unable to survive the changes in the climatic conditions brought about by the gradual cooling of the earth.[57] But, since these species will reappear in other places, given the proper physico-chemical conditions, it cannot be said that their type is lost.

The ancient fossils could now be explained in two ways: (1) the fossils which resemble modern day animals represent the only species which Nature has allowed to sustain themselves; (2) the fossils which have no living likeness are the remains of species that have disappeared on earth.

At the beginning of this chapter it was asserted that

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[56] HN., 13: 40. "defective monsters, these imperfect sketches a thousand times projected and executed by Nature, which scarcely having the faculty to exist, must only have existed for a time, . . ."

[57] HNM., 4: 156-63.

Buffon's reconciliation of organic change with the idea of the moule intérieur slowly emerged from his many volumes of the Histoire naturelle. As the foregoing discussion of Buffon's ideas has shown, by distinguishing between the purity of the moule intérieur of each species and the instability and fleeting existence of individual living things Buffon kept true to his belief that nature never alters her plans and her order but that she does alter and change particular things. Individuals come and go, change, are degraded, and degenerate, but the moule intérieur, as a type of organic organization, of each species is fixed by the laws of Nature and thus will always be the same. The alteration of individuals belonging to a particular species-genus depends upon the circumstances of the individuals and the ability of the form, that is, the moule intérieur, to fix its type upon organisms. Individuals of any species-genus change more in certain environments, and certain species are more prone to alterations under any circumstances than others. Alterations upon individuals can be profound, but the imprint of the type itself is not altered at all.

Those scholars who have seen Buffon as a full-fledged transformist, then, are simply wrong. The moules intérieurs are the immediate effects of the laws of Nature and not the products of any evolutionary process. If anything, rather than anticipating nineteenth-century evolutionary theories, Buffon espoused the Parmenidean belief that that which exists must persist forever. Buffon's desire was to insure the stability and structure of the universe; evolution of organic forms to Buffon would have been tantamount to his saying that the universe has no order, no stability -- no laws. Buffon's idea

of the species as the physical manifestations of universal types of organized organic matter shows how far his thought was from a Darwinian type of evolutionary theory. His idea of the species is more akin to Aristotle's than Darwin's.

Before discussing Buffon's theory of organic change in light of variations within the human species, a summary of the salient points brought out in this chapter will be useful.

(1) Basic organic forms, since they result from and depend upon physical laws, cannot fundamentally change. That is to say, the laws of reproduction which dictate the formations of moules intérieurs insure that the basic kinds of organisms will only reproduce -- no matter the external influence -- their own likenesses.

(2) Organic alteration, although never fundamentally changing the types of organisms, can be profound, depending upon the ability of the various types of moules intérieurs to impose their form upon organic molecules.

(3) The most profound alterations within species-genera are not the result of the direct action of environmental factors upon organisms. Deep alterations are caused when organisms ingest organic matter that has been affected by an environment unlike the one in which their prototype (first moule intérieur) was formed.

(4) Buffon's acceptance of genera was based upon his belief, expressed in the preface to his translation of Vegetable Staticks, the preface to his translation of Newton's Fluxions, the "Premier discours" to the Histoire naturelle, and in many articles throughout the Histoire naturelle, that the only acceptable scientific

ideas must be grounded in empirical evidence, that is, facts. Genera exist because he found factual evidence of their existence in his experiments with hybrids. By analogy, if they exist among domestic animals, he assumed they probably exist among certain wild animals.

CHAPTER VI

THE RACES OF MANKIND

The Background

The purpose of this chapter is to determine how Buffon fitted man into his theory of life. Man is unique in Nature, but in Buffon's eyes he is not unique for any extramundane reason. Man's singularity must be searched for in the history of the world and the processes inherent in the living realm. Buffon never referred to a special creation of man, and he did not divorce man's existence from the laws of Nature. Nor was man free of degeneration.

Although the highest form of life, and thus less prone to degeneration than all other species, there are degenerate varieties in the human family. For example, Buffon believed that the American Indians, like all forms of life in the New World, show signs of weakness and perversion: their sexual organs are small and the men lack ardour for their women. Black peoples in Africa and elsewhere, he thought, are ugly, deformed in mind and body, and bestial.

But before elaborating on Buffon's thoughts on human racial formation, it will be useful to consider the general attitude of Europeans in the eighteenth century toward other races and cultures and to discuss the various kinds of explanations, other than Buffon's, for the existence of the human varieties. In this manner, Buffon's contribution can be better appreciated.

In an essay entitled "Of National Characters" David Hume (1711-1776) wrote the following:

> I am apt to suspect the negroes, and in general all the other species of men (for there are four or five different kinds) to be naturally inferior to the whites. There never was a civilized nation of any other complexion than white, nor even any individual eminent either in action or speculation. No ingenious manufactures amongst them, no arts, no sciences. On the other hand, the most rude and barbarous of the whites, such as the ancient GERMANS, the present TARTARS, have still something eminent about them, in their valour, form of government, or some other particular. Such a uniform and constant difference could not happen in so many countries and ages, if nature had not made an original distinction betwixt these breeds of men. Not to mention our colonies, there are NEGROE slaves dispersed all over EUROPE, of which none ever discovered any symptoms of ingenuity; tho' low people, without education, will start up amongst us, and distinguish themselves in every profession. in JAMAICA indeed they talk of one negroe as a man of parts and learning; but 'tis likely he is admired for very slender accomplishments, like a parrot, who speaks a few words plainly.[1]

Most Europeans did not consider, as Hume did, blacks to be so inferior as to constitute a separate species of man, but it was not unusual, particularly in the second half of the eighteenth century, for Europeans to think that Black Africans were somehow deficient in their humanity.[2] Some even went so far as to assert that

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[1]David Hume, The Philosophical Works, eds. Thomas Hill Green and Thomas Hodge Grose, 4 vols. (reprint ed. of the 1882 London edition, Darmstadt: Scientia Verlag Aalen, 1964), 3: 252n.

[2]Winthrop D. Jordan, White over Black: American Attitudes toward the Negro, 1550-1812 (Baltimore: Penguin Books, Inc. 1969), chapters five and six (Hereinafter referred to as White over Black); Richard H. Popkin, "The Philosophical Basis of Eighteenth-century Racism," in Racism in the Eighteenth Century, ed. Harold E. Pagliaro, Studies in Eighteenth-century Culture, vol. 3 (Cleveland and London: The Press of Case Western Reserve University, 1973), pp. 245-62; Sloan, "The Idea of Racial Degeneracy in Buffon's Histoire Naturelle," pp. 293-321; Charles H. Lyons, To Wash an Aethiop White: British

Negroes, along with the Hottentots (Hottentots were often considered as a particularly bestial kind of Negro), were perhaps the races nearest in their physique and temperament to beasts: their dark skins, the texture of their hair (often referred to as wool), the shape of their heads, the fullness of their lips, and the size of their genitals seemed proof that Negroes were tainted with animal traits. The largeness of the Negro's genitals in particular gave evidence of their bestiality: large genitals indicated lascivious, ape-like sexual appetites. So animalistic in their sexual desires were Negroes that rumour had it in Europe and white America that Negro women copulated, perhaps willingly, with apes.[3]

More than anything else, though, it was the African's black skin that was most unsettling to the whites, particularly those whites from northern Europe.[4] An early seventeenth-century French traveler remarked: "It might be properly said, that these Men [Negroes] came out of Hell, they were so burnt, and dreadful to look upon."[5]

Ideas about Black African Educability, 1530-1960 (New York: Teachers College Press, 1975), pp. 24-51 (Hereinafter referred to as Aethiop); Thomas F. Gossett, Race: The History of an Idea in America (Dallas: Southern Methodist University Press, 1963), pp. 32-53 (Hereinafter referred to as Race); David Brion Davis, The Problem of Slavery in Western Culture (Ithaca, New York: Cornell University Press, 1966), pp. 446-482 (Hereinafter referred to as Slavery); and Philip D. Curtin, The Image of Africa: British Ideas and Action, 1780-1850 (Madison: The University of Wisconsin Press, 1964), pp. 28-57 (Hereinafter referred to as the Image of Africa).

[3]Jordan, White over Black, pp. 236-239.

[4]Ibid., p. 4. See pages 216-65 for a discussion of the meanings eighteenth-century savants gave to the African's black skin. See also Lyons, Aethiop, p. 2 and Davis, Slavery, p. 447.

[5]Cited in Davis, Slavery, p. 447.

A great deal of the white man's aversion for black people can be explained by the fact that westerners associated the color black with the negative side of existence:

> Black was the color of death, of the River Styx, of the devil; it was the color of bad magic and melancholy, of poison, mourning, forsaken love, and the lowest pit of hell. There were black arts and black humours, blackmail and blacklists, blackguards and black knights, the Black Death and 'souls as blak as pykke.'[6]

It is little wonder that the blackness of the African's skin was associated with the blackness of his being.

While black was associated with everything that was negative, white was associated with all that was positive and good. For example, white symbolized beauty, virtue, purity, cleanliness, virginity, godliness, justice, truth, pleasure, and joy.[7]

Next to the black Africans, the American Indians intrigued the whites, especially the white Americans. While sometimes thought to have inferior physical features (for example, in contrast to the blacks, Buffon believed that the Indian's genitals were smaller than the European's) and mental abilities,[8] it was the savagery of the Indians that fascinated most whites.[9] The American Indians, sometimes hailed as "noble savages," particularly in the eighteenth century,

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[6]Ibid., pp. 447-48.

[7]Ibid., p. 448; Jordan, White over Black, pp. 7-11; and Lyons, Aethiop, pp. 2-3; and The Compact Edition of the Oxford English Dictionary (1971), s. v. "White," p. 3764.

[8]Infra., pp. 136-37.

[9]Jordan, White over Black, pp. 26-27.

were at other times seen as ignoble, brutish, perfidious, and without feelings; they were examples of the depths to which the human character would fall without the benefits of civilization.[10] To the Puritan settlers the "Indians were emblems of external temptation to sin or of the human mind's impulses to sin."[11]

Other peoples, in particular those living in extreme climatic conditions, were also considered to be degraded peoples. In one of the first attempts to classify the human races according to physical features, an essay probably written by François Bernier (1620-1688), the Lapps were called "vilains animaux."[12] Linnaeus, though far from being an extreme racist, stated that the Asiatics were "severe, haughty, covetous," and "Governed by opinions."[13] James Burnet, Lord Monboddo (1714-1799) insisted that there were people who had tails.[14] Hume argued that "indeed there is some reason to think, that all the nations, which live beyond the polar circles or between

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[10]Edwin T. Martin, Thomas Jefferson: Scientist (New York: Henry Schuman, 1952), pp. 148-174.

[11]Richard Slotkin, Regeneration Through Violence: The Mythology of the American Frontier, 1600-1860 (Middletown, Connecticut, Wesleyan University Press, 1973), p. 40.

[12]"Nouvelle division de la terre, par les differentes especes ou races d'hommes qui l'habitent, envoyée par un fameux voyageur à monsieur * * * * * à peu prés en ces termes," Journal des Sçavans 12 (April 1684): 151. (Hereinafter referred to as "Nouvelle division.")

[13]Linné, A General System of Nature, 1: 9.

[14]Greene, The Death of Adam, p. 218.

the tropics, are inferior to the rest of the species, and are incapable of all the higher attainments of the human mind."[15] But no peoples held the attention of the whites as did the American Indians and the Black Africans.

As Europeans and the whites in the New World became increasingly conscious, from the seventeenth century on, of the distinctions between themselves and the nonwhites, questions concerning the origins of these distinctions became onerous and demanding. How does the existence of diverse races square with the Biblical notion that all people were created in the image of God? Perhaps the races are really different species of men. But if that is true, how does one account for the fact that the Bible explicitly states that all humanity descended from Adam and Eve? And how does one explain the fact that a male and a female from two different races produce fertile offspring? On the other hand, if all humanity constitutes one species -- and most agreed that it does -- what caused the great differences in color, bodily shape, hair, and intelligence in the various varieties?

One means, more popular in earlier centuries than it was in the eighteenth century, of explaining the Negro's black skin was the belief that God had cursed the ancestors of the Negroes with a black skin. One story had it that Negroes represent the descendants of Ham (Cham), the son of Noah, who showed contempt for his father by looking upon his nakedness. Because of Ham's shameful behavior, God cursed Canaan, Ham's son, and all of Canaan's descendants with a

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[15]Hume, The Philosophical Works, 3: 252.

black skin.[16] At other times, according to A. Owen Aldridge, it was asserted that the curse of a black skin had been visited upon the descendants of the Biblical Cush, grandson of Noah and son of Cain.[17]

Although relatively few, there apparently were those in the seventeenth and eighteenth centuries who continued to believe the ancient theory that dark skins were caused by the imagination of pregnant women being struck by some dark object.[18]

But these nonmaterialistic causes of the dark skin of the Negro were unacceptable to the growing number of naturalists in the late seventeenth and early eighteenth centuries who believed that observable phenomena were perforce the effects of natural causes. A satisfactory answer, however, proved elusive. Ephraim Chambers (c.1680-1740) wrote in the 1728 Cyclopaedia that "The origin of Negro's, and the cause of that remarkable difference in complexion from the rest of mankind, has much perplexed the naturalists; nor has any thing satisfactory been yet offered on that head."[19]

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[16]Lyons, Aethiop, pp. 11-12; Jordan, White over Black, pp. 17-18.

[17]A. Owen Aldridge, "Feijoo and the Problem of Ethiopian Color," in Racism in the Eighteenth Century, ed. Harold E. Pagliaro, Studies in Eighteenth-century Culture, vol. 3 (Cleveland and London: The Press of Case Western Reserve University, 1973), pp. 265-66.

[18]Ibid., pp. 267-69.

[19]Cyclopaedia: Or, an Universal Dictionary of Arts and Sciences; Containing an Explication of the Terms, and an Account of the Things Signified Thereby, in the Several Arts, both Liberal and Mechanical; and the Several Sciences, Human and Divine: the Figures, Kinds, Properties, Productions, Preparations, and Uses of Things Natural and Artificial: the Rise, Progress, and State of Things Ecclesiastical, Civil, Military, and Commercial: with the Several

Many naturalists in the late seventeenth and early eighteenth centuries sought an environmental explanation for the diversity in the human species. Air, water, heat, and food were some of the climatic elements that were thought to be the efficient cause of racial differences, particularly skin color.

The popularity of the environmental position can be traced to antiquity. The idea that climate alters human beings goes back at least to the ancient Greeks. In an essay entitled Airs, Waters, and Places, often said to have been written by Hippocrates of Cos, differences in mental attributes as well as bodily shapes among different kinds of people were ascribed to the climatic conditions of their homes. The dwellers on the Phasis river were described in the following manner:

> Their land is marshy, hot, wet, and wooded; copious violent rains fall there during every season. The inhabitants live in marshes, and their dwellings are of wood and reeds, built in the water. They make little use of walking in the city and the harbour, but sail up and down in dug-outs made from a single log, for canals are numerous. The waters which they drink are hot and stagnant, putrefied by the sun and swollen by the rains. The Phasis itself is the most stagnant and most sluggish of all rivers. The fruits that grow in this country are all stunted, flabby and imperfect, owing to the excess of water, and for this reason they do not ripen. Much fog from the waters envelops the land. For these causes, therefore, the physique of the Phasians is different from that of other folk. They are tall in stature, and of a gross habit of body, while neither joint nor vein is visible. Their complexion is yellowish, as though they suffered from jaundice. Of all men they have the deepest voice, because the air they breathe is not clear, but moist and turbid. They are by nature disinclined for physical fatigue. There are but slight changes

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Systems, Sects, Opinions, &c. among Philosophers, Divines, Mathematicians, Physicians, Antiquaries, Critics, &c. The whole intended as a Course of Antient and Modern Learning, s.v. "Negro's."

of the season, either in respect of heat or of cold.[20]

Aristotle was also convinced that character is influenced by the climate:

> This is a subject which can be easily understood by any one who casts his eye on the more celebrated states of Hellas, and generally on the distribution of races in the habitable whole. Those who live in a cold climate and in Europe are full of spirit, but wanting in intelligence and skill; and therefore they retain comparative freedom, but have no political organization, and are incapable of ruling over others. Whereas the natives of Asia are intelligent and inventive, but they are wanting in spirit, and therefore they are always in a state of subjection and slavery. But the Hellenic race, which is situated between them, is likewise intermediate in character, being high-spirited and also intelligent. Hence it continues free, and is the best-governed of any nation, and, if it could be formed into one state, would be able to rule the world.[21]

Marcus Pollio Vitruvius (fl. 1st c. B.C.), the Roman writer of the important On Architecture, written between 27 and 13 B.C., attributed the superiority of Romans to the rarity of their atmosphere and to the heat of their climate. The Northerners have a "sluggish intelligence" because they are "enveloped in a dense atmosphere, and chilled by moisture from the obstructing air, . . ."[22]

Isidore of Seville (d. 636), the encyclopedist of the early

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[20]Hippocrates Airs Waters Places 15. 1-30, trans. W.H.S. Jones in Hippocrates, 4 vols. (London: William Heinemann; New York: G.P. Putnam's Sons, 1923), 1: 113.

[21]Aristotle Politica $1327^{b}20$-35, trans. Benjamin Jowett in The Works of Aristotle Translated into English, ed. by W.D. Ross, vol. 10: Politica, Oeconomica, Atheniensium-Respublica (Oxford: At the Clarendon Press, 1921; reprint ed., 1946).

[22]Vitruvius Pollio, The Ten Books on Architecture, trans. Morris Hicky Morgan (Cambridge: Harvard University Press, 1914), p. 173.

Middle Ages, who compiled bits and pieces of ancient learning, wrote that in

> accordance with diversity of climate, the appearance of men and their color and bodily size vary and diversities of mind appear. Thence we see that the Romans are dignified, the Greeks unstable, the Africans crafty, the Gauls fierce by nature and somewhat headlong in their disposition which the character of the climates bring about.[23]

The black skins of the Ethiopians (black Africans) are caused by the heat of the sun: "Ethiopia is so called from the color of its people, who are scorched by the nearness of the sun. The color of the people betrays the sun's intensity, for there is never-ending heat there."[24]

It was not until Europeans began global expansion and came into direct contact with truly black Negroes, American Indians, and other exotic people during the sixteenth and seventeenth centuries that an *environmental argument* was again used to any extent to explain differences between the races.

Johan Albert Fabricius (1668-1736), the anatomist, thought that all mankind derived from the "protoplast" of one parent. The causes of racial differences lay in the food eaten, air inhaled, water drunk, as well as the temperature. All of these factors can be seen to have caused the black skin of the African.[25] This degenerate darkness is in time "propagated with the blood itself and is an efficient cause of carrying on the blackness to posterity."[26]

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[23]Cited in J.S. Slotkin, ed., Readings in Early Anthropology (Chicago: Aldine Publishing Company, 1965), p. 3. (Hereinafter referred to as Readings.)

[24]Ibid.

[25]Ibid., p. 192. [26]Ibid.

In an Essay Concerning the Effects of Air on Human Bodies (1733), a widely read treatise, Dr. John Arbuthnot (1667-1735), who was greatly influenced by Hippocrates, wrote that air was the principal cause of racial diversities. Arbuthnot first stated that "This Diversity of National Features and Shapes is not altogether the Effect of Propagation from the same original Stock; for it is known by Experience, that Transplantation changeth the Stature and outward Shape, both of Plants and Animals."[27] Having settled the fact that environment has a noticable influence on the plants and animals, Arbuthnot then assured his readers that the characteristics of the air in various climates are the primary agents of human skin color:

> That the Complexion depends much upon the Air, is plain from Experience; the Complexion of the Inhabitants of several Countries being fair, swarthy, black and adust, according to the Degrees of Heat, Drought, Moisture, or Coolness of the Air. The Inhabitants of Countries in great Latitudes are generally fairer than those that live nearer the Sun.[28]

The air not only influences the physical features of people, it also affects their temperament:

> That the Temper and Passions are influenc'd by the Air, is no less certain: People of delicate Nerves and moveable Spirits are often joyful, sullen, sprightly, defected, hopeful, dispairing, according to the Weather; and these Changes happen, but pass unobserv'd in stronger Constitutions.[29]

Benito Gerónimo Feijoo (1676-1764), a Spanish cleric, wrote

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[27]John Arbuthnot, An Essay Concerning the Effects of Air on Human Bodies (London: Printed for J. and R. Tonson and S. Draper, 1751), pp. 146-47.

[28]Ibid., p. 148.

[29]Ibid.

an essay, "Color etiopico" (1739), in which he contended that the black color of the Negroes is caused by the climate of the country they inhabit. More specifically, it is the vapors exhaled by their land which cause the peculiar color of the Negroes:

> Y los vapores, exhalaciones, ò corpusculos de la atmosphera, què son sino efluvios de la tierra? Leugo esto, ò los cuerpos de donde se exhalan, se deben reconocer (regularmente hablando) por causa de las particulares qualidades buenas, ò malas de el Pais.[30]

Pierre Bouguer (1698-1758), who, along with Charles-Marie de La Condamine (1701-1774), Louis Godin (1704-1760), and Joseph de Jussieu (1704-1779), was a member of the famous French expedition to Peru (1735), concluded that the physical differences, skin color included, between the whites and the South American Indians are caused by climate. In the Mêmoires de l'Académie des Sciences (1744), Bouguer wrote:

> . . . mais si on admet que leur couleur qui en général est si distincte de la nôtre, vient de la température du climat, ou de la grande action de l'air . . . , il semble qu'on peut soupçonner que les autres accidens dépendent à peu près des mêmes causes.[31]

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[30]Benito Gerónimo Feijoo, "Color ephiopico," in Theatro critico universal, o discursos varios en todo genero de materias, para desengaño de errores comunes, 9 vols. (Madrid: En la Imprenta de los Herederos de Francisco del Hierro, 1739), 7: 87. "And vapors, exhalations, or corpuscules of the atmosphere, what are they if not effluvia of the earth? Then these, or the bodies from where they exhale, must be recognized, commonly speaking, for the cause of the particular good or bad qualities of the nation."

[31][Pierre] Bouguer, "Relation abrégée du voyage fait au Pérou par messieurs de l'Académie Royale du Sciences, pour mesurer les degrés du méridien aux environs de l'équateur, & en conclurre la figure de la terre," Mémoires de l'Académie Royale des Sciences, (1744): 274. ". . . but if we admit that their color, which is in general

Charles-Louis de Secondat, Baron de la Brède et de Montesquieu (1689-1775), in one of the most influential books written in the eighteenth century, De l'esprit des lois (1748), said that southern and northern people differ in their characters because of their respective climates. In cold, northern countries people tend to be insensitive to pain, brave, weakly sexed, intelligent, and lovers of the hunt, war, and wine. In hot lands people have no curiosity, undertake no noble endeavors, and are generally passive.[32]

As popular as the environmental explanations of human differences were in the early part of the eighteenth century, they were not without their critics. There were those, for example, who pointed out that fourth and fifth generation Negroes living in North America were no lighter in their skin color than were their ancestors from Africa. Pehr Kalm (1716-1779), a student of Linnaeus, after a visit to America wrote:

> The negroes have therefore been upwards of a hundred and thirty years in this country. As the winters here, especially in New England and New York, are as severe as our Swedish winter, I very carefully inquired whether the cold had not been observed to affect the color of the negroes, and to change it, so that the third or fourth generation from the first that came hither became less black than their ancestors. But I was generally answered that there was not the slightest difference of color to be perceived; and that a negro born here of parents who were likewise

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distinct from ours, comes from the temperature of the climate or from the great action of the air . . . , it seems that we can conjecture that the other accidents depend upon almost the same causes."

[32][Charles-Louis de Secondat, Baron de la Brède et de] Montesquieu, Oeuvres complètes de Montesquieu, ed. Jean Brethe de la Gresseye, vol. 2: De l'esprit des loix (Paris: Société les Belles Lettres, 1955), pp. 189-93.

> born in this country, and whose ancestors, both men and women had all been blacks born in this country, up to the third or fourth generation, was not at all different in color from those negroes who were brought directly from Africa. Hence many people concluded that a negro or his posterity did not change color, though they continued ever so long in a cold climate; but the union of a white man with a negro women, or of a negro man with a white women had an entirely different result.[33]

Like Kalm, many naturalists in the late seventeenth and early eighteenth centuries noticed that, irrespective of the external conditions, the skin color of the Negro was transmitted unchanged from one generation to another generation. They concluded that such physical features were not, consequently, accidental effects of environmental conditions. No matter how racial characteristics are acquired they are an essential part of a human's organic makeup. The cause of the differences between the races, therefore, should be searched for in the structure of the human body. In an article probably written by Bernier it was stated that

> La noirceur qui leur est essentielle, & dont la cause n'est pas l'ardeur de Soleil, comme on le pense; puisque si l'on transporte un noir & une noire d'Afrique en un Païs froid, leurs enfans ne laissent pas d'etre noirs aussi bien que tous leurs descendans jusques à ce qu'ils se marient avec des femmes blanches. Il en faut donc chercher la cause dans la contexture particuliere de leur corps, ou dans la semence, ou dans le sang qui sont neanmoins de la même couleur que par tout ailleurs.[34]

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[33]Cited in Jordan, White over Black, pp. 243-44.

[34]"Nouvelle division," p. 150. "Blackness, of which the cause is not the heat of the Sun, is essential to them; for if we transport a Negro and a Negress from Africa to a cold Land, their children will not stop being black as all their descendants -- until they unite with white women. It is necessary, therefore, to search for the cause [of blackness] in the particular contexture of their bodies, or in the semen, or in the blood, which are nevertheless of the same color as everywhere else."

Believing that Negroes were not simply white men with burned skins, some investigators attempted to discover the physiological and/or anatomical causes of black skins. Black blood,[35] a black epidermis,[36] a reticular membrane between the skin and the epidermis[37] -- all of these were seen as responsible for the Negro's peculiar skin color. The most common view, however, seems to have been that the Negro's skin contains a black fluid, often thought to be black bile.

Although the idea that the Negro's skin was full of black bile was a prominent one, nobody seemed to be able to find such a fluid. However, in 1741, Pierre Barrère (c. 1690-1755), a French physician and anatomist, declared he had conducted experiments which proved the existence of such a substance. In a treatise entitled Dissertation sur la cause physique de la couleur, des Nègres, de la qualité de leurs cheveus, & de la génération de l'un & de l'autre (1741), which won the competition set up by the Bordeaux Academy for the best essay on the causes of the Negro's black skin, Barrère, after several dissections of Negro cadavers, claimed that black bile, unlike the yellow bile of the whites, is permanently diffused throughout the epidermis of the Negro.[38] In effect, Barrère's black bile

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[35]HN., 3: 524.

[36]Jaques-Benigne Winslow, Exposition anatomique de la structure du corps humain, new ed., 4 vols. (Amsterdam: Chez J. Wetstein, 1743), 3: 278.

[37][Bernard le Bovier de Fontenelle], "Diverses observations anatomique," Histoire de l'Académie Royale des Sciences, (1702): 32.

[38]Long excerpts from Barrère's essay are contained in an unsigned review in the Journal des Sçavans 132, May 1742, pp. 23-45.

theory contended that the Negro had a kind of permanent jaundice. His theory only strengthened the rather common notion that the black skin of the Negro was a sign of his sick, degraded, and degenerated character.

About 1743, an American, Dr. John Mitchell (d. 1768), wrote a paper entitled "An Essay upon the Causes of the Different Colours of People in Different Climates" in which he argued against the fluid theory. As it was the most thoroughgoing attempt to explain skin color in terms of Newton's theory of light, Mitchell's theory deserves a detailed discussion.

Like Barrère, Mitchell had intended to enter his essay in the competition created by the Bordeaux Academy for the best essay on the causes of the Negro's black skin. Unfortunately, his paper arrived too late to compete, but he did send it to Peter Collinson (1694-1768), the well-known disseminator of American scientific knowledge, and it was read serially before the Royal Society of London between May 3 and June 14, 1744.[39] Agreeing that the color of the Negro's skin was due to climatic conditions,[40] Mitchell, surprisingly for an American, stated that this did not indicate any basic difference between whites and blacks.[41] Using Newton's explanation of

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[39]Raymond Phineas Stearns, Science in the British Colonies of America (Urbana, Chicago, London: University of Illinois Press, 1970), p. 545.

[40]John Mitchell, "An Essay upon the Causes of the Different Colours of People in Different Climates," Philosophical Transactions, no. 474, 43 (June-December 1744): 131.

[41]Ibid.

colors as presented in the Opticks, Mitchell stated that he could explain the color of the Negro by studying the structure of the skin:

> . . . if I can deduce the Colour of the Skin from its Structure, &c. in the same manner, and for the same Reasons, from which the great Newton deduces the Colours of other Substances, it is all I can pretend to, which will be as much as that Branch of Philosophy will permit: . . .[42]

Mitchell, maintaining that the color of Negroes is not caused by any so-called black humour (bile), thought that their blackness was due to the thickness of their skin: "The Skins of Negroes are of a thicker Substance, and denser Texture, than those of white People, and transmit no Colour thro' them."[43] Tying his theory of skin to Newton's theory of colors, Mitchell wrote:

> . . . Sir Isaac Newton explains to us (Opt. ib. Prop. II.); where he shews, that the Opacity of Bodies depends upon the Multitude of Reflexions that are made in their internal Parts; but it is very plain, that the thicker the Skin is, the more Reflexions the Rays of Light must suffer in passing thro' it, by which they will be extinguished, in proportion to the Number of such Reflexions; that is, the more opaque, or less white, it must appear: So that, altho' the Particles, of which white and dark skinn'd People are composed, may not be very different from one another, as they seem not to be; yet a greater Number of such combined Particles, or more Strata of them, in thick Skins, and the Smallness of the intervals in Skins of a dense Texture, will increase the Number of Reflexions made in their internal Parts, or the Opacity of them; which renders them less white, since their Whiteness proceeds from the Number of the transmitted Rays.[44]

Darkness or lightness of skin color, then, Mitchell thought, is a relative thing which depends upon the thickness of the skin and

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[42] Ibid., p. 103.

[43] Ibid., p. 107.

[44] Ibid., p. 123.

not upon innate differences between black and white people:

> . . . there is not so great, unnatural, and unaccountable a Difference between Negroes and white People, on account of their Colours, as to make it impossible for both ever to have been descended from the same Stock, as some People, unskilled in the Doctrine of Light and Colours, are very apt too positively to affirm, and, without any Scruple, to believe, contrary to the Doctrine (as it seems to be) of the Sacred Pages.[45]

In contrast to Mitchell's belief that Negroes and whites descended from the same stock, there were a number of religiously unorthodox Europeans -- usually not naturalists -- in the eighteenth century who were convinced that the differences between themselves and other races of men were not merely differences of degree but rather differences of kind: whites constitute a different and superior species than the other species of men.[46] The point of view that Negroes, for example, constitute a separate species of man was perhaps more widespread in France than in other parts of Europe.[47] Polygenesis, the belief that the various races had a separate formation, was especially attractive to the philosophes.[48] The idea that the whites and the other races were distinct species was not confined to France, however. As has been shown, David Hume believed in multiple human species. John Atkins (1685-1757), an English surgeon and traveler, declared in 1735 that "tho' it be a little Hexterdox, I am

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[45]Ibid., p. 131.

[46]Gossett, Race, pp. 44-51; Greene, The Death of Adam, p. 362n; and Curtin, The Image of Africa, pp. 41-42.

[47]Davis, Slavery, p. 454 and Curtin, The Image of Africa, pp. 41-42.

[48]Curtin, The Image of Africa, pp. 41-42.

persuaded the black and white Race have, ab origine,sprung from different-coloured first Parents."[49]

Although the theory of multiple human species accounted rather nicely for the bodily and temperamental differences between the races, there was one overriding factor, besides the religious one, which kept it a minority opinion. It was a well-known fact that all the human races were reproductively compatible, which, of course, gave strong evidence that all mankind was one. Most naturalists throughout the eighteenth century continued to search for the cause or causes that had led to mankind's diversification.

Not recognized for his ideas on the origins of the races in his own time, Henry Baker (1698-1774), a poet, a naturalist, and a member of the Royal Society, suggested the idea that whole races can develop from the perpetuation of organic deformities. Baker, after noticing that the six offspring of a man with a prickly skin bore his abnormality, stated that a whole race of prickly skinned people might "be propagated by this man, . . ."[50] And

> 'tis not improbable they might be deemed a different species of mankind: a consideration, which would almost lead one to imagine, that if mankind were all produced from one and the same stock, the black skins of the negroes, and many other differences of the like kind, might possibly have been originally owing to some such accidental cause.[51]

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[49]Slotkin, Readings, p. 193

[50]Henry Baker, "A Supplement to the Account of a Distempered Skin, Published in the 424th Number of the Philosophical Transactions," Philosophical Transactions, 49 (1755): 23.

[51]Ibid.

To the extent that Maupertuis thought that racial characters are hereditary, he agreed with Baker; however, he was not altogether certain how, for example, "noir est devenu une couleur héréditarie aux grandes familles qui peuplent la Zone torride; . . ."[52] Probably, Maupertuis reasoned, in a manner similar to Baker's, it was due to the perpetuation of some organic accident.[53] At any rate, the torrid zone is more favorable to the particles that compose black skin than to those which constitute white skin.[54]

According to Maupertuis, the black varieties of man, and all kinds of men, are variant forms of the original white type. The fact that white offspring are born relatively often to Negro parents indicates that even though their black color has become hereditary, the original white type is not totally lost and from time to time asserts itself.[55]

Maupertuis' explanation of the races, unique in the suggestion that perhaps the diversities in the human races are due to the perpetuation of organic accidents (the cause of which he was not certain) and not the direct influence of the environment, shared with the environmentalists the assumption that the white race was the prototype man from which all other human varieties have deviated. And

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[52]Maupertuis, Les Oeuvres de Mr. de Maupertuis, p. 265. "black became a hereditary color of the great families which people the torrid zone, . . ."

[53]Ibid.

[54]Ibid., p. 263.

[55]Ibid., p. 264.

like most environmentalists, Maupertuis believed that any deviation from the white type was considered a degeneration. Degenerate peoples were understood to mean those who had lost at least some of the characteristics (intelligence, beauty, white skin, to name a few) associated with white peoples living in European cultures.

By the middle of the eighteenth century, however, no satisfactory theory as yet existed to explain what caused the degeneration of human beings. The ancient notion that environmental factors somehow cause degeneration remained little more than a belief. And the purely anatomical and physiological works on such problems as skin color avoided the issue of degeneration altogether. As Buffon stated in a critique of Barrère and others,

> il est probable que la bile & le sang sont plus bruns dans les Nègres que dans les blancs, comme la peau est aussi plus noire; mais l'un de ces faits ne peut pas servir à expliquer la cause de l'autre, car si l'on prétend que c'est le sang ou la bile qui, par leur noirceur, donnent cette couleur à la peau, alors au lieu de demander pourquoi les Nègres ont la peau noire, on demandera pourquoi ils ont la bile ou le sang noir; ce n'est donc qu'éloigner la question, au lieu de la résoudre.[56]

But Buffon was convinced that he, unlike most naturalists, had the solution to the mystery of human degeneration. Within the context of his general theory of organic alteration, as discussed in the previous chapter, Buffon presented an explanation of how environments,

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[56]HN., 3: 525. "it is probable that the bile and the blood are darker in Negroes than in whites, as the skin is also darker. But one of these facts cannot help to explain the cause of the other, because if one asserts that it is the blood or the bile which, by their blackness, gives this color to the skin, then instead of asking why Negroes have black skin, one will ask why they have black bile or blood. That is, therefore, only to postpone the question instead of resolving it."

acting indirectly through the organic molecules, cause not only black skins but all the characteristics of inferior peoples. The remainder of this chapter is devoted to a discussion of Buffon's theory of organic alteration and how it relates to the human species.

"Variétés dans l'espèce humaine"

In the "Variétés dans l'espèce humaine" (1749), his first major effort at explaining the origins of the human varieties, Buffon presented a theory which attempted to explain how nonwhites had degenerated into inferior human beings. For the most part Buffon's position was little different from most other eighteenth-century environmental arguments: racial differences, Buffon maintained in the "Variétés," are caused by the direct influence of environmental factors. Nowhere did he state, as he later did in explaining organic alterations of the quadrupeds, that these factors interfere with the functions of the moule intérieur.

In the "Variétés" Buffon stated that all of the human races belong to the same species. Although mankind is one, there are differences within the human species. As human populations grew in number and covered the surface of the earth, they were altered in their physical and tempermental character by the environment in which they settled.[57] They have often degenerated; that is, the climate in which they live is so harmful that their physical and mental characteristics have become less and less human. They have become less

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[57] HN., 3: 529-30.

able to reason, very often small and wrinkled, brown or black, and ugly.[58]

Thus, although mankind is a single species, the races are not all equally well-made or equally beautiful. According to Buffon, and, as noted before, a good many other Europeans, the white Europeans not only have the true and natural color of man, they are also better made and more beautiful than other peoples. The mark of a race's beauty is how closely they resemble the handsome and well-proportioned Europeans. Buffon wrote:

> Le climat le plus tempéré est depuis le 40me degré jusqu'au 50me, c'est aussi sous cette zone que se trouvent les hommes les plus beaux & les mieux faits, c'est sous ce climat qu'on doit prendre l'idée de la vraie couleur naturelle de l'homme, c'est-là où l'on doit prendre le modèle ou l'unité à laquelle il faut rapporter toutes les autres nuances de couleur & de beauté, les deux extrêmes sont également éloignés du vrai & de beau: les pays policés situés sous cette zone, sont la Georgie, la Circassie, l'Ukraine, la Turquie d'Europe, la Hongrie, l'Allemagne méridionale, l'Italie, la Suisse, la France, & la partie septentrionnale de l'Espagne, tous ces peuples sont aussi les plus beaux les mieux faits de toute la terre.[59]

Degenerate peoples are not always small. For example, some American Indians are not always smaller than Europeans. [See Infra. p.136.]

HN., 3: 528. "The most temperate climate is between the 40th and 50th degrees. Thus, it is under this zone that the most beautiful and the best made men are found. It is in this climate that one must take the idea of the true and natural color of man. It is there that one must take the model or the unity from which it is necessary to relate the nuances of color and beauty. The two extremes are equally removed from truth and from beauty. The civilized countries situated under this zone are Georgia, Circassia, Ukraine, European Turkey, Hungary, Southern Germany, Italy, Switzerland, France, and the northern part of Spain. All of these people are the most beautiful and the best made in all the world."

However, besides the strictly aesthetic judgment that white was the color of man's progenitors, there was the fact that some Negroes were white. Like Maupertuis, whose work in the Vénus physique he cited, Buffon thought the fact that white offspring are born quite often to Negro and Indian parents but that dark skinned offspring are never born to white parents proved that white was the natural color of man:

> . . . ce qu'il y a de plus singulier, c'est que cette variation de la Nature ne se trouve que du noir au blanc, & non pas du blanc au noir; car elle arrive chez des Nègres, chez les Indiens les plus bruns, & aussi chez les Indiens les plus jaunes, c'est-à-dire, dans toutes les races d'hommes qui sont les plus éloignees du blanc, et il n'arrive jamais chez les blancs qu'il naisse des individus noirs; . . . Le blanc paroît donc être la couleur primitive de la Nature, . . .[60]

While the most beautiful people live in Europe, the most degenerate groups of people live in areas furthest from the temperate zones -- in regions where there is too little or too much heat. Buffon spoke pejoratively of all peoples living in extremely northern regions as small, ugly, tawny, savage, and stupid.[61] The Laplanders, the Eskimos, and others living in the extreme north, in Buffon's view, are perhaps the most degenerate peoples on earth. "Cette race est, . . . , bien differente des autres, il semble que ce soit une

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[60]HN., 3: 502. ". . . what is most singular is that this variation of Nature is only found from black to white and not from white to black, because it happens with Negroes, with the darkest Indians, and also with the most yellow Indians, that is to say, in all the races furthest from white, and it never happens that whites give birth to black individuals; . . . White appears, therefore, to be the primitive color of Nature, . . ."

[61]Ibid., pp. 371-79.

espèce particulière. . . ."[62] At the other extreme, certain black peoples living in the torrid zone Buffon spoke of as being as degenerate as the northerners. For example, he stated that those inhabitants of the coast of New Holland are the people nearest to brutes.[63] Like the people of the extremely cold regions, most people of very hot regions exhibit all the characteristics of a degenerated people; they are savage, ugly (although Buffon admitted that certain black Africans could be considered beautiful because -- excepting their color -- they have physical traits similar to Europeans)[64] and stupid.[65]

Even the most deformed, corrupted peoples, however, are not necessarily hopelessly relegated to their unhappy state. Their weakened minds and vitiated bodies will regain vigor if they are removed from extreme climates and transplanted in a temperate climate. For example, although the blackness of the Negroes is passed from parent to child, Negroes can be freed of their deformed black skins if removed to a northern land. Possibly thinking of reports like Kalm's that the third and fourth generation of Negroes living in North America are just as dark skinned as their fellow Negroes in Africa,

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[62] Ibid., p. 372. "This race is . . . very different from others; it seems that it is a particular species."

[63] Ibid., p. 408.

[64] Ibid., pp. 457-58.

[65] Some African Blacks are more degenerate than others. West Africans are darker and more degenerate than the relatively light skinned and well-made East Africans. (See Ibid., pp. 448-50.) The people living between the Moors in the north and the Negroes in the south, although tawny, are relatively light, and tolerably well-made in comparison with their southern neighbors. (See Ibid., p. 448.)

Buffon stated that the dissipation of the Negroes' blackness would be an exceedingly slow process. But by the eighth, tenth, or twelfth generation their skins would be fairer, and perhaps eventually they would be as white as the northerners.[66] Degenerate characteristics, then, do not become an inherent part of the organic makeup of changed people.

Although it is the intensity of a climate's heat that Buffon appeared to consider the most prominent factor in the determination of a people's physical features and tempermental character, food is a concomitant but additional environmental factor which can be used to explain the variations within the human species. By appealing to this additional factor, Buffon was able to explain why, for example, people living in the same regions are nonetheless of a different color, shape, or nature. The peoples living on one side of the Senegal river in Africa are black while their neighbors on the other side are relatively light skinned. Buffon accounted for this apparent anomaly by asserting that the differences in their diet account for the differences in their skin color.[67]

The effects of a climate can also be abated and diverted by a high level of civilization. If, Buffon speculated, a savage and a civilized people live in the same climate, the savage people will be uglier, darker, smaller, and more wrinkled. If the savages are in any way superior, it is in their strength and hardness of their

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[66] Ibid., pp. 523-24.

[67] Ibid., p. 481.

bodies -- apparently because they are forced by their circumstances to exert more energy than are civilized people. The civilized people will be more handsome and better made, for they are not at the full mercy of the environment: the civilized people will create a society in which the kinds of activity, the kinds of food, the kinds of labor, and the kinds of shelter will lessen the full impact of an untamed environment.[68]

In his "Variétés," Buffon made no attempt to explain how the various environmental factors were able to produce alterations upon the human body and mind. As a matter of fact, Buffon said that he did not want to discuss at that time how great heat, for example, acts to cause darker skins. He wrote:

> . . . nous ne voulons pas chercher ici comment cette cause [chaleur] agit, mais seulement nous assurer qu'elle agit, & que ses effets sont d'autant plus grands & plus sensibles, qu'elle agit plus fortement & plus longtemps.[69]

Such was Buffon's solution in 1749 to the problem of human racial formation. There are several features of his explanation which need to be summarized. First, Buffon was convinced that racial characters are a result of the environmental conditions of geographical regions and the level of civilization. Human racial characteristics are, as they are with all other organisms, a result of natural causes working through time; they are not innate "marks," nor are they the result of curses. Secondly, Buffon tended to view racial

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[68] Ibid., pp. 446-47.

[69] Ibid., p. 526. ". . . we do not here want to search for how this cause [heat] acts, but only to assure ourselves that it does act, and that its effects are greater and more sensible in proportion to the strength and length of time of its action."

characteristics as a degeneration of the body and mind from the original characteristics of man's first parents, who were white and lived in temperate zones. The extremes of degeneracy, however, are reversible. There is no mention of how the environment causes alterations in the physical and mental characteristics of man. There is no mention of the moule intérieur.

Buffon never did explicitly state that alterations within the human species were the result of organic molecules interfering with the power of the moule intérieur to impose the pristine human form on the offspring of the various races. It is, nonetheless, reasonable to infer that he believed organic variation occurs within the human species in the same manner and for the same reasons that it occurs in all other species, since , as will be shown presently, Buffon became convinced that the most profound alterations in men result from the influence of food (organic molecules) upon their interior forms.

The 1760's

It is not surprising to find that certain of Buffon's fundamental ideas about the various human races did not change at all between the 1750's and 1766. Throughout this period, Buffon continued to believe that the human species, although subject to alteration, was the least altered of all the species. Degeneration and change, with the human species even more than with the other animals, remained merely the nonessential and reversible afflictions of certain groups of individuals who live in less than optimal environments. Extreme heat and extreme cold were still considered by Buffon in 1765 the worst environments.[70]

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[70] HN., 13: vi.

White Europeans, consequently, still constituted for Buffon the best formed and the most superior kind of human beings: they live in the temperate zones of Europe, the most favored environment for man.

However, by 1766, Buffon had come to think that man, along with the other species, was subject to more profound changes than he had been apparently willing to admit in the "Variétés" (1749). Whereas in 1749 he did not state how degeneration worked, and appears to have thought that the effects of degeneration were the direct influence of environmental factors on the external parts of man, by 1766 he argued that causes of the most profound degeneration, transmitted through ingested food, attack the interior where the processes of reproduction work to cause the passage of the human form from one generation to the next. In other words, the causes of the most profound degeneration are the same for man as other organisms. In reference to man, Buffon wrote in 1766:

> . . . c'est principalement par les alimens que l'homme reçoit l'influence de la terre qu'il habite, celle de l'air & du ciel agit plus superficiellement; & tandis qu'elle altère la surface la plus extérieure en changeant la couleur de la peau, la nourriture agit sur la forme intérieure par ses propriétés qui sont constamment relatives à celles de la terre qui la produit.[71]

It is, therefore, the food as products of environments and not the environments themselves which cause the deepest, most lasting alterations in man. It follows, then, that civilized peoples, who are able to control their environment, will be able, in part at

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[71] HN., 14: 315. ". . . it is principally by food that man reaps the influence of the earth he inhabits; that of the air and the sky acts more superficially: whereas they alter the most exterior surface in changing the color of the skin, the nourishment acts on the interior form by its properties, which are constantly relative to that of the earth which produces it."

least, to determine their own organic destiny: if the environment is controlled, the agents (the food) of alterations are controlled.

What this means, as will be shown shortly, is that those peoples living on wild, uncultivated, or geologically new lands, such as exist in America, will not only suffer relatively superficial external degeneration but they will also lose the uniquely human ability to think profoundly. They will become mere creatures of their will, controlled by the exigencies of their immediate needs; they will in fact be brutes. In Buffon's mind the degeneration of the human species became increasingly identified with a weakening of man's mental acuity.

Since civilization can compensate, at least in part, for the influence of even the worst climate, Buffon in the 1760's and 1770's, even more than in 1749, viewed uncivilized people in the least propitious environments as the most degenerated people on earth. Whereas in 1749 it had been the peoples living in the extreme north that Buffon had often spoken of as the most degraded, by the 1760's it appeared that the American Indians and the Black Africans had acquired that ignominy. Buffon's emphasis upon the Indians and Blacks more than likely reflects the eighteenth-century European's growing interest about Africa and America. At any rate, the American Indians and the Blacks were the two types of men Buffon used when writing in the 1760's and the 1770's of human degeneration.

In the less active, less lively New World, men are very much degenerated, although the effects of their degeneration are not so visibly apparent as with the Blacks. The men of the New World, Buffon wrote in 1761, are approximately the same size as the men of the Old World, but "le Sauvage [du nouveau monde] est foible & petit par les

organes de la génération; . . ."[72] The male Indian has no hair on his body, no beard (which Buffon thought indicated a lack of virility), and lacks ardour for his female; he is a cold, melancholy being. The Indian is timid and ugly when compared to the European. He has no mental life; he is a creature of need and necessity -- not really a man at all, he is closer to a brute: "il demeurera stupidement en repos sur ses jambes ou couché pendant des jours entiers."[73]

A more obviously degenerated people than the Indians -- at least in terms of appearance and anatomy -- are certain black Africans. Buffon stated, for example, that Hottentots were almost as ugly and as wild as orangutans.[74] But even more indicative of Buffon's belief that Blacks are extremely degenerated was the fleeting suggestion that perhaps Negro women breed successfully with apes -- a suggestion that makes an organic connection between the apes and man through the Negro. He almost immediately rejected the idea as soon as he had suggested it, however. He did so not because he rejected the inferiority of the Black Africans, but because he believed that all peoples, no matter their degenerate state, constitute the one genus with a soul and a mental life. The existence of these two uniquely human characteristics constituted, in fact, an unbridgeable barrier between all other animals and man.[75]

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[72]HN., 9: 104. "the savage [of the New World] has weak and small organs of generation."

[73]Ibid. "he will remain stupidly at rest on his heels, or will lie down whole days at a time."

[74]HN., 14: 30-32.

[75]Ibid., pp. 31-32.

Buffon's refusal to consider man and the great apes as belonging to one great family goes back to the very beginnings of the Histoire naturelle. In the essay "De la nature de l'homme" (1749), in what appears to have been another attack upon Linnaeus -- this time for placing man in the same class with apes and sloths -- Buffon stated that while it is correct to consider man an animal, one should not carelessly place man in abstract categories along side other animals, no matter the external similarities between some other animals and man.[76] And "quoique les ouvrages du Créateur soient en eux-mêmes tous egalement parfaits, l'animal est, selon notre façon d'apercevoir, l'ouvrage le plus complet de la Nature, & l'homme en est le chef-d'oeuvre."[77]

In the "Nomenclature des singes" (1766) Buffon, armed with information taken from a book written by Edward Tyson (1650-1708) entitled Orang-Outang: Or the Anatomy of a Pygmy Compared With That of a Monkey, an Ape, and a Man (1699), found what he thought to be convincing proof that physical resemblance to man did not guarantee a creature's inclusion in the family of man. Even though orangutans are equipped with brains and tongues, they cannot think and they cannot talk.

> Ainsi ce singe, que les Philosophes, avec le vulgaire, ont regardé comme un être difficile à définir, dont la nature étoit au moins équivoque & moyenne entre celle de l'homme & celle des

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[76] HN., 2: 437-41.

[77] HN., 2: 2. "although the works of the Creator are in themselves all equally perfect, the animal is, according to our way of perceiving, the most complete work of Nature, and man is the masterpiece."

> animaux, n'est dans la vérité qu'un pur animal, portant à l'extérieur un masque de figure humaine, mais dénué à l'intérieur de la pensée & de tout ce qui fait l'homme; . . .[78]

The 1770's and the "Epoques"

After one finds Buffon speaking of Blacks in such obviously perjorative terms in 1766, it comes as something of a shock to find in volume two of the "Suppléments" (1775) the suggestion put forth in the form of a question that the Negro race may be older than the white race.[79] And later, in the manuscript version of the "Époques," Buffon implied that the black race was formed before the white race when he stated that the first people were formed in Siberia during the fifth epoch when Siberia was as hot as the torrid zones are at the present time.[80] This fits into Buffon's late (1770's) cosmological and geological view.[81] If all like species appeared during a particular epoch propitious to their formation, the formation of man, in order that Nature be consistent with herself, must have occurred at the same time as the formation of the creatures with the same organic structure, that is, the quadrupeds.

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[78] HN., 14: 41. "Thus this ape, which the Philosophers, as well as the vulgar, have regarded as a difficult being to define, and whose nature is at least equivocal and intermediate between that of man and of animals, is, actually, only a downright animal, bearing the external marks of the human figure, but deprived in the interior of thought and of anything that constitutes man; . . ."

[79] HNS., 2: 564.

[80] [Georges-Louis Leclerc, comte de] Buffon, Les époques de la nature, ed. Jacques Roger, Mémoires du Muséum National d'Histoire Naturelle, Série C, Science de la terre, vol. 10 (Paris: Editions du Museum, 1962), pp. LXXIV-LXXV.

[81] Ibid., pp. LXXIII-LXXXI.

In light of the fact that Buffon considered most alterations away from the original organic form of a species as a degeneration, is it possible that between 1766 and 1775 he came to believe that white peoples had degenerated from black peoples? Hardly. Though suggesting that black was the skin color of the first humans, Buffon did not, at the same time, change his opinion regarding the superiority of the white race. While in 1749 Buffon viewed the white man as the prototype of mankind, by 1778 he thought that the white race was an improved race and the only variety of man worthy of being called people.[82] In the "Époques," Buffon argued that it was after the earth had cooled that the white race appeared in the newly formed temperate climates -- which are the most beneficial to the development of human intelligence and inventiveness -- of the seventh and last epoch. With their superior intelligence these white people created the first truly civilized culture, that is, a culture in which knowledge was used to control Nature to the extent that the degenerating agents which exist even in temperate climates were either eliminated or their force lessened. As the benefits of a civilized culture accumulated and degenerating influences were continually removed from their environment, these first white people became increasingly superior, both mentally and physically, to non-white peoples.[83]

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[82] HNS., 5: 229.

[83] Buffon implied this when he stated that the first civilized people degenerated back into a brutish state after the destruction of their culture. (See Ibid., p. 235.)

One finds Buffon's final reasoning on this matter of the inferiority of the uncivilized nonwhites and the superiority of the white, civilized Europeans in a section of the "Époques" entitled "Septième et dernière époque lorsque la puissance de l'homme a secondé celle de la Nature." The first people on earth were not civilized and thus were subjected to the caprice of a wild, uncontrolled Nature -- a Nature full of vicious animals, volcanos, and inundations. Man during his first years on earth was a miserable, defenseless creature who survived only when he used his intelligence to control his environment. The first men had, however, neither large societies nor knowledge of Nature's operations, the two requisites for civilization.[84]

It was during the calm after the initial great storms on earth that certain men finally founded "par la connoissance des effets & des opérations de la Nature; . . ."[85] civilized societies. They were the first "peuple digne de porter ce nom, digne de tous nos respects, comme créateur des sciences, des arts & toutes les institutions utiles: . . ."[86] The civilized societies did not appear in Africa, Europe, and certainly not in America. It was "dans les contrées septentrionales de l'Asie que s'est élevée la tige des

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[84]HNS., 5: 225-27.

[85]Ibid., p. 227. "by the knowledge of the effects and the operations of Nature; . . ."

[86]Ibid., p. 229. "people worthy of carrying this name, worthy of all our respect as creators of the sciences, arts, and all the useful institutions: . . ."

connoissances de l'homme; & c'est sur ce tronc de l'arbre de la science que s'est élevé le trône de sa puissance: . . ."[87] over Nature. All of this wisdom and power

> suppose les hommes actifs dans un climat heureux, sous un ciel pur pour l'observer, sur une terre féconde pour la cultiver, dans une contrée privilégiée, a l'abri des inondations, éloignée des volcans, plus élevée, & par conséquent plus anciennement tempérée que les autres.[88]

All of these conditions were found in the center of the Asian continent, "depuis le 40.e degré de latitude jusqu'au 55.e."[89] It is the same temperate latitude that Buffon mentioned in the "Variétés" as containing the whitest and most beautiful people on earth.[90]

Buffon's idea that the first great civilization existed in northern Asia probably had its roots, in part at least, in remarks that Jean Bailly (1736-1793), his friend and protégé, made in the first three chapters of his Histoire de l'astronomie ancienne (1775). Bailly wrote that Buffon was impressed with Bailly's use of such classic myths as Proserpine and Hercules and the Amazons to strengthen his contention that the first high civilization appeared in the

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[87] Ibid., p. 228. "it was in the northern countries of Asia that arose the first stem of man's knowledge; and it is on this trunk of the tree of science that arose the throne of his power: . . ."

[88] Ibid. "assumes active men in a favorable climate with a pure sky made for observation and a fruitful earth made for cultivation; in a privileged country protected from inundations, far from volcanos, higher, and consequently mild at an earlier time than others."

[89] Ibid. "from the 40th degree of latitude to the 55th."

[90] Supra., p. 129.

North.[91] Bailly wrote:

> Ces idées d'un peuple antérieur & de son habitation primitive vers le nord, ont paru neuves à M. de Buffon, qui a bien voulu lire l'ouvrage entier. Il a vu avec satisfaction une analogie marquée entre les faits fournis par l'Histoire & l'Astronomie, les conjectures tirées des fables, & ses propres vues sur le réfroidissement de la terre.[92]

At any rate, the ancient civilized Asians were not the first people on earth; they were, rather, the first people who were civilized, that is, who had knowledge of science and technology. They were extremely learned, having a higher degree of civilization than the well-known and relatively modern civilizations of antiquity, such as the Greek, Egyptian, Chaldean, Chinese, and Roman.[93] The halcyon and prosperous days of science and learning in this most ancient civilization lasted about three thousand years. After these three thousand years of existence these people of high learning and civilization were destroyed by hordes of barbarians from the north.[94] The Northerners destroyed the memory of all science "en sorte que trente siècles d'ignorance ont peut-être suivi les trente siècles de lumière

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[91][Jean] Bailly, Histoire de l'astronomie ancienne, depuis son origine jusqu'a l'établissement de l'École d'alexandrie (Paris: Chez les freres Debure, 1775), p. 103.

[92]Ibid., p. 103n. "These ideas of a former people and their early residence toward the north appear to have been new to M. de Buffon, who has wanted very much to read the entire work. He has seen with satisfaction a marked analogy between the facts furnished by History and Astronomy, the conjectures drawn from myths, and his own views on the freezing of the earth."

[93]HNS., 5: 230-35.

[94]Ibid., pp. 233-34.

qui les avoient précédés."[95] Only the dregs, the mere shadows, of this civilization were passed to posterity. Only a kind of metaphysical corruption of the knowledge obtained by this first civilization remained in some later societies to remind us that something was passed on to other people having a large enough population to benefit from the knowledge.

Although science was lost, the technology which science had given birth to was not lost, and new civilizations arose periodically in various places where the population was large enough to sustain them. The ancient empire of China arose first, followed shortly by Atlantis in Africa, and then by peoples on the continent of Asia, then Egypt, Ethiopia, and finally Rome, from which the existing European civilization obtained its laws and customs.[96]

Though the idea that history should be seen more in terms of man's ascent from savagery rather than his decline from an original state of perfection became more and more common in the eighteenth century,[97] some believed that civilization might be a mixed blessing. Could it be possible that man in a savage state was kinder, more at peace with himself, and, in a word, more natural than civilized man? Buffon suggested such a thing early in the Histoire naturelle (1749):

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[95]Ibid., p. 234. "so that thirty centuries of ignorance perhaps followed the thirty centuries of light which had preceded them."

[96]Ibid., pp. 234-36.

[97]Greene, The Death of Adam, p. 203.

> Un sauvage absolument sauvage, tel que l'enfant élevé avec les ours, dont parle Conor, le jeune homme trouvé dans les forêts d'Hanower, ou la petite fille trouvée dans les bois en France, seroient un spectacle curieux pour un philosophe, il pourroit en observant son sauvage, évaleur au juste la force des appétits de la Nature, il y verroit l'ame à decouvert, il en distingueroit tous les mouvemens naturels, & peutêtre y reconnoitroit-il plus de douceur, de tranquillité & de calme que dans la sienne, peut-être verroit-il clairement que la vertu appartient à l'homme sauvage plus qu'à l'homme civilisé, & que le vice n'a pris naissance que dans la sociéte.[98]

By now it should be clear that such a view was not characteristic of Buffon's thinking. People who remain outside society and thus without knowledge and technology are unhappy, miserable brutes: "l'homme enfin sans éducation, sans morale, réduit à mener une vie solitaire & sauvage, n'offre, au lieu de sa haute nature, que celle d'un être dégradé au-dessous de l'animal."[99] Being stupid and lazy "ces hommes à demi-brutes, ces nations non policées, grandes ou petites, ne font que peser sur le globe sans soulager la Terre, l'affamer sans la féconder, détruire sans édifier, tout user sans rien

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[98]HN., 3: 492-93. "An absolute savage, such as the child raised with bears, as mentioned by Conor, the young man found in the forests of Hanover, or the small girl found in the woods of France, would be a spectacle full of curiosity for a philosopher: in observing his savage he will have a means to ascertain the force of the appetites of Nature; he will see the soul undisguised; he will distinguish all natural movements. Perhaps he will find in it more mildness, more serenity and peace than in his own. Perhaps he will see clearly that virtue belongs to the savage man more than to the civilized man, and that vice takes birth only in society."

[99]HNS., 5: 235. "men finally without education, without morals, reduced to leading a solitary and savage life, offers, instead of his elevated nature, only that of a being degraded below an animal."

renouveler."[100] For example, Buffon requested, compare the small savage of America and the half-civilized people of Africa "avec nos grands peuples civilisés" and "vous jugerez aisément du peu de valeur de ces hommes par le peu d'impression que leurs mains ont faites sur leur sol: . . ."[101]

Most eighteenth-century savants agreed with Buffon that the civilized state is preferable to the savage state. Even Jean-Jacques Rousseau (1712-1778), who lamented the loss of western man's innocence and yearned for the simpler times of ancient Rome and Sparta, and Denis Diderot (1713-1784), who presented Tahitian tribesmen as naturally noble and wise, had little nostalgia for man's savage state.[102] Their so-called "primitivist" writings -- Rousseau's Discours sur l'origine et les fondements de l'inégalité parmis les hommes (1755) and Diderot's Supplément au voyage de Bougainville (1796) -- were in fact criticisms of western civilization rather than panegyrics of savagery. In these works, Diderot and Rousseau offered views of man living free of hypocrisy, without mendacity, tyrannical institutions, or barbarous mores -- all of which they believed plagued western man.[103]

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[100]Ibid., p. 237. "these half brutish men, these uncivilized nations, large or small, are only burdening the globe without succoring the earth, exhausting without producing, destroying without edifying, using everything without renewing anything."

[101]Ibid. "with our great civilized peoples" and "you will judge easily of the little value of these men by the slight impression their hands have made on their soil: . . ."

[102]Peter Gay, The Enlightenment: An Interpretation, vol. 2: The Science of Freedom (New York: Alfred A. Knopf, 1969), pp. 94-96.

[103]See Jean-Jacques Rousseau, Discours sur l'origine et les fondements de l'inégalité parmi les hommes (Paris: Editions sociales, 1954), pp. 108-45 and Denis Diderot, Supplément au voyage de Bougainville (Genève: Librairie Droz and Lille: Librairie Giard, 1955), pp. 21-49.

Far from wanting to revert to man's primitive state -- which Rousseau knew was impossible -- Diderot and Rousseau desired to reform western civilization. "For Rousseau, as for Diderot, the cure for the sickness of civilization is more, and authentic, civilizations."[104]

The importance Buffon attached in the seventh epoch (and elsewhere) to civilization, then, was not unique by the late eighteenth century, but the novelty of why he considered it important ought now to be evident. In Buffon's mind the useful benefits of science and technology, the two requisites of civilization, were not simply in their roles as a means to improve man's social and economic well-being, but in the improvement of his very organic form. Man's organic form is improved when he gains some control, through his knowledge of Nature's processes, over his climate and the food (organic molecules) he ingests. Since the unfortunate American Indians, Black Africans, and indeed all inferior peoples have neither science nor anything more than a primitive technology, they are, in Buffon's eyes, unimproved, that is, brutish kinds of human beings -- human beings whose bodily features and temperaments are almost totally determined by the hostile environment which nourishes them. Thus, Negroes are closer, as noted earlier, in their anatomy to apes.[105]

Buffon's idea that peoples without science and technology are inferior types of men, then, fitted well with the ethnocentric feeling common in Europe that white peoples were somehow superior to all

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[104]Gay, The Science of Freedom, p. 96.

[105]Supra., p. 137.

nonwhites. Even more, it seemed to make scientifically respectable for the first time the conviction that became commonplace in the nineteenth century that the "lower" races are mentally incapable of shouldering the burdens of complex civilization and will slowly deteriorate to a point where they cannot compete with the superior, white peoples.[106] If that is the case, then Buffon can be viewed as giving impetus to the growing racism in the late eighteenth and early nineteenth centuries.

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[106]John S. Haller, Jr., Outcasts from Evolution: Scientific Attitudes of Racial Inferiority, 1850-1900 (Urbana, Chicago, London: University of Illinois Press, 1971), p. ix.

CHAPTER VII

LATE EIGHTEENTH-CENTURY REACTION TO BUFFON'S THEORY OF RACE

So far there has been little attempt in this work to assess the significance of Buffon's speculations for later eighteenth-century theories of race. It is not the intent of this chapter to do that in any detail; that kind of effort is outside the scope of this dissertation, and, so to speak, "involves another can of worms." The most that can be done here is to ferret out those elements of Buffon's thought which appear to have had the greatest impact on the writings of others.

Buffon's racial speculations were certainly available to the literate public in Europe. Translated into German, English, Italian, and Spanish during the eighteenth century, the Histoire naturelle was an enormously popular work.[1] Daniel Mornet estimated that among the private libraries in France during the Enlightenment the Histoire was the third most frequent holding. The Encyclopédie

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[1]Genet-Varcen and Jacques Roger, "Bibliographie de Buffon," O.P., p. 527.

of d'Alembert and Diderot, by comparison, ranked in a relatively low twenty-first position.[2]

But Buffon's work was equally respected in the New World. Thomas Jefferson (1743-1826) called Buffon "the best informed of any Naturalist who has ever written."[3] Benjamin Franklin (1706-1790) claimed Buffon was "a philosopher deservedly of great reputation in France and indeed all over Europe, . . ."[4] In 1768 Buffon was elected to the American Philosophical Society.[5] And he was counted as a mighty adversary in the Americans' dispute with the Europeans over the relative merits of the New and Old World.[6]

Given the fact that the Histoire naturelle was such a well-known work, it is not surprising that Buffon's influence can be seen in many late eighteenth-century treatises on the human races. Among those who wrote on racial matters but who are usually not considered naturalists, Buffon's explanation of the cause of human varieties often had a profound influence. Oliver Goldsmith (1728-1774), who is known primarily as a creative writer, was one of those. One historian has stated:

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[2]Daniel Mornet, "Les enseignements des bibliothèques privées (1750-1780)," Revue d'histoire littéraire de la France 17 (1910): 460.

[3]Thomas Jefferson, Notes on the State of Virginia, ed. William Peden (Chapel Hill: University of North Carolina Press, 1955), p. 55.

[4]Benjamin Franklin, The Autobiography of Benjamin Franklin (Berkeley and Los Angeles: University of California Press, 1949), pp. 190-91.

[5]Martin, Thomas Jefferson: Scientist, p. 152.

[6]Ibid., chapter 8.

> . . . Oliver Goldsmith, whose knowledge of natural history, according to Dr. Samuel Johnson, extended no further than an ability to distinguish a cow from a horse, relied upon Buffon as gospel in his History of the Earth and Animated Nature [1774].[7]

Indeed, in his discussion on the varieties of mankind, Goldsmith followed Buffon's arguments in the "Variétés" (1749) slavishly. There is virtually nothing in Goldsmith's work that cannot be found in greater detail in Buffon's work. There is no need to discuss Goldsmith's explanation of the origins of the human race. Let it suffice to say that he used exactly the same arguments (at times almost word for word) as Buffon did to explain how nonwhite peoples have degenerated from their beautiful and well formed white ancestors, why white is the natural color of man, and why American Indians, who live in equatorial regions, are not as dark as Black Africans living at the same latitude.[8]

But Goldsmith's feelings about the inferiority of certain degenerate peoples were perhaps even more intense than Buffon's. Laplanders are "all equally rude, superstitious, and stupid."[9] The Negroes of Guinea in West Africa "are extremely ugly, and have an insupportable scent; . . ."[10] They have flat and short noses, thick and tumid lips. Their white teeth (their single mark of beauty) only

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[7]Ibid., p. 152.

[8]Oliver Goldsmith, An History of the Earth, and Animated Nature, 8 vols. (London: Printed for J. Nourse, 1774), 2: chapter 11.

[9]Ibid., p. 214.

[10]Ibid., p. 226.

make "the contrast between the black and white . . . the more observable."[11] They are, Goldsmith concluded, "stupid, indolent, and mischievous."[12]

In contrast to the lowly Negroes, however, the Europeans are splendid specimens:

> The sixth and last variety of the human species, is that of the Europeans, and the nations bordering on them. In this class we may reckon the Georgians, Circassians, and Mingrelians, the inhabitants of Asia Minor, and the northern parts of Africa, together with a part of those countries which lie north-west of the Caspian Sea. The inhabitants of these countries differ a good deal from each other; but they generally agree in the colour of their bodies, the beauty of their complexions, the largeness of their limbs, and the vigor of their understanding. Those arts which might have had their invention among the other races of mankind, have come to perfection there.[13]

Buffon was not universally popular, however. Henry Home, Lord Kames (1696-1782), the Scottish man of letters, rejected Buffon's concept of species as well as his theory of racial formation. Kames, at times with biting sarcasm, strongly objected to the idea that the species are groups of individuals which produce fertile offspring. Since even Buffon admitted, Kames stated, that two separate species, such as goats and sheep, "produce a mixed breed which generate for ever,"[14] it is wrong to think that species are determined by reproductive compatibility.[15]

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[11] Ibid., p. 227.

[12] Ibid., p. 228.

[13] Ibid., pp. 230-31.

[14] [Henry Home, Lord Kames] Sketches of the History of Man, 4 vols. 2nd. (Edinburgh: Printed for W. Strahan, T. Cadell, and W. Creech, 1778), 1: 12.

[15] Ibid., pp. 10-19.

Thus, just because all the types of men are reproductively compatible does not mean they all belong to the same species. God, Kames asserted, has divided mankind into several different species, each one suited specifically for a particular climatic condition.[16]

And each of the races are essentially different. Contrary to Buffon's opinion, the differences exhibited by these races cannot be ascribed to environmental causes.

> Can one hope for belief in ascribing to climate the low stature of the Esquimaux, the smallness of their feet, or the overgrown size of their head; or in ascribing to climate the low stature of the Laplanders, and their ugly visage. Lapland is indeed piercingly cold; but so is Finland, and the northern parts of Norway, the inhabitants of which are tall, comely, and well proportioned. The black colour of negroes, thick lips, flat nose, crisped woolly hair, and rank smell, distinguish them from every other race of men.[17]

Kames brought forth much evidence to disprove the idea that the environment permanently changes men. All the American Indians are of a uniform color, even though they live in diverse climates; Europeans still give birth to white children after long years in the tropics; southern Chinese are white;[18] and the "women of fashion in the island Otaheite, who cover themselves from the sun, have the European complexion."[19]

It is true, Kames conceded, that people degenerate outside the specific climate in which God intended them to live; but

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[16]Ibid., p. 75.

[17]Ibid., p. 25.

[18]Ibid., pp. 27-28.

[19]Ibid., p. 27.

degeneration, in Kames' mind, did not also involve racial alteration. In climates unfit for them, men merely become weak and sickly; if the environment is too unsuitable for their constitutions, they eventually die.[20]

Dr. John Hunter (d. 1809)[21] defended Buffon's concept of species against the attacks upon it by Kames and others. In the first place, Hunter argued, Kames' idea that God created the different human races does not solve the problem of racial distinctions; rather, it merely avoids the issue by removing the question of races outside scientific enquiry. In an argument similar to the one Buffon leveled against the followers of pre-existence, Hunter stated that to explain everything in nature that one does not understand as an act of God is to too severely limit the province of natural philosophy.[22] In the second place, Hunter averred, Kames never defined what he meant by species, and yet proceeded "to pronounce the species of men to be different."[23]

Hunter's definition of species is similar to Buffon's. A species, Hunter wrote, is a "class of animals, of which the members procreate with each other, and the offspring of which also procreate

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[20]Ibid., p. 22.

[21]This Dr. John Hunter should not be confused with the other Dr. John Hunter (1728-1793), the famous surgeon and anatomist.

[22]John Hunter, An Inaugural Dissertation in The Anthropological Treatises of Johann Friedrich Blumenbach, trans. and ed. Thomas Bendyshe (London: Longman, et al., 1865), p. 360.

[23]Ibid., p. 362.

other animals, which are either like their class, or afterwards become so."[24] Thus, if the males produced from a union of "a most beautiful Circassian woman and . . . an African born in Guinea, as black and ugly as possible . . ."[25] only breed with Negroes and their sons with Negroes and so on for several generations, eventually no traces of the white race would remain. If the female line of this union mates only with whites, eventually all traces of the black race would be lost.[26]

Buffon figured prominently in Hunter's explanation of the human varieties of man. Buffon was cited as an authority on certain aspects of organic alteration of animals and man[27] and on the fixity of the human species.[28] Information in regard to the influence of air and sun on the human skin,[29] the small stature of people living in frozen regions,[30] the sexual appetites of people living in hot and cold climates,[31] and races without beards[32] were all taken from the Histoire.

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[24]Ibid., p. 363.

[25]Ibid., pp. 363-64.

[26]Ibid.

[27]Ibid., pp. 365, 377, 378.

[28]Ibid., pp. 364-65.

[29]Ibid., p. 375.

[30]Ibid., p. 379.

[31]Ibid.

[32]Ibid., p. 383.

Johann Friedrich Blumenbach (1752-1840), the author of De generis humani varietate nativa (1776) and one of the outstanding anatomists and anthropologists of the late eighteenth and early nineteenth centuries,[33] disagreed with Hunter in regard to Buffon's definition of the species. Blumenbach did not believe that Buffon's interbreeding criterion was a practical or sufficient means of determining species. In the first place, Blumenbach rhetorically asked, "what very little chance is there of bringing so many wild animals, . . . , to that test of copulation?"[34] In the second place, characters belonging to some varieties are just as constant as any specific character could possibly be.[35] The only means of proceeding toward an idea of species is "from analogy and resemblance."[36] Without knowing, for example, that Asian and African elephants have ever copulated together, the invariable differences (at least in the elephants he had examined) in their molar teeth seemed to indicate, Blumenbach thought, that they are different species.[37] The main point here is that Blumenbach thought Buffon's definition of species impractical, even if true.

It is very difficult to determine to what degree Buffon's

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[33]Haller, Outcasts From Evolution, pp. 4-5.

[34]Johann Friedrich Blumenbach, On the Natural Variety of Mankind in The Anthropological Treatises of Johann Friedrich Blumenbach trans. and ed. Thomas Bendyshe (London: Longman, et al, 1865), p. 189.

[35]Ibid., p. 190.

[36]Ibid.

[37]Ibid.

work influenced Blumenbach's theory of human racial formation. Blumenbach was an environmentalist, and in many respects his explanation of the origins of the various races is much like Buffon's. Blumenbach, for instance, believed that climate, mode of living, and diet can cause the degeneration of organisms by interfering with the reproductive processes.[38] But he did not indicate that he had taken any part of the idea from Buffon. As a matter of fact, Blumenbach mentions Buffon's work surprisingly little. His only direct reference to Buffon in conjunction with human variation was to state that Buffon attributed the black skins of Negroes mostly to the climate.[39] Most often Buffon's name is brought up in regard to matters other than the cause of human diversification. For example, he praised Buffon, von Haller, and Linnaeus for their strong stand against polygenesis and their refusal -- in contrast to Lord Monboddo -- to include the apes in the family of man.[40] But whether his theory of human racial formation owes any considerable debt to Buffon or not, Blumenbach was certainly very familiar with Buffon's work and thought him to be one of the greatest naturalists.[41]

While most naturalists in the late eighteenth century continued to believe that mankind is one species, there were some --

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[38] Ibid., pp. 193-95.

[39] Ibid., p. 210n.

[40] Ibid., pp. 296-97.

[41] Ibid., p. 297.

often extreme racists -- who believed, like Kames, that each kind of man is a separate species. Edward Long (1734-1813) was one of those. In his History of Jamaica (1774), Long used parts of Buffon's work to help prove that the white species of man was the highest form of human being and that the Negroes and Hottentots were the lowest.

Though he used Buffon's work when it helped strengthen his case against Black Africans, Long was highly critical of Buffon's environmentalism. Buffon, Long argued, was wrong in his belief that heat could cause the black skin of the Africans. Long gave several reasons why heat cannot cause black skin. American Indians living on the same latitude as Negroes living in Guinea are nonetheless not black. White men in the tropics do not slowly become black, and Negroes living in cold climates do not lose their blackness.[42]

> And lastly, the whole fabric of Mr. Buffon's hypothesis is subverted at once, by the race on Albinoes, in the very heart of Guiney; who, although subject to the same intense heat of climate, which, he says, has caused the black colour of Negroes, are unaccountably exempted from the influence of this cause, though equally exposed to it.[43]

Rather, Long contended, white and black men differ essentially.[44] Negroes have "A covering of wool, like bestial fleece, instead of hair."[45] They have round eyes, oddly shaped ears, tumid nostrils,

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[42]Edward Long, The History of Jamaica. Or, General Survey of the Antient and Modern State of that Island: with Reflections on its Situation, Settlements, Inhabitants, Climate, Products, Commerce, Laws, and Government, 3 vols. (London: Printed for T. Lowndes, 1774), 2: 351n-52n.

[43]Ibid.

[44]Ibid. p. 351.

[45]Ibid., p. 352.

flat noses, thick lips, large nipples,[46] and a "bestial or fetid smell, which they all have in a greater or less degree; . . ."[47] Furthermore, the lice which inhabit their bodies are unnaturally black.[48] But most of all they are uncommonly stupid and barbarous:

> In general, they are void of genius, and seem almost incapable of making any progress in civility or science. They have no plan or system of morality among them. Their barbarity to their children debases their nature even below that of brutes. They have no moral sensations; no taste but for women; gormondizing, and drinking to excess; no wish but to be idle. The children, from their tenderest years, are suffered to deliver themselves up to all that nature suggests to them. Their houses are miserable cabbins. They conceive no pleasure from the most beautiful parts of their country, preferring the more sterile. Their roads, as they call them, are mere sheep-paths, twice as long as they need to be, and almost impassable. Their country in most parts is one continued wilderness, beset with briars and thorns. They use neither carriages, nor beasts of burthen. They are represented by all authors as the vilest of the human kind, to which they have little more pretension of resemblance than what arises from their exterior form.[49]

In contrast to true men, that is, white men, Negroes are "a brutish, ignorant, idle, crafty, treacherous, bloody, thievish, mistrustful, and superstitious people, . . ."[50]

All of these bestial characteristics of the Negroes led Long to rhetorically ask whether Negroes were men at all: "When we reflect on the nature of these men, and their dissimilarly to the rest of mankind, must we not conclude, that they are a different species of the

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[46] Ibid.

[47] Ibid.

[48] Ibid.

[49] Ibid., p. 353.

[50] Ibid., p. 354.

same genus?"[51] The answer seemed obvious. Armed with a belief in the great chain of being and using information drawn primarily from Buffon's comparison of the orangutan and man,[52] Long concluded that the orangutan is an intermediate species between man and the apes and that the Black African fills the space between the orangutan and those who are fully human.[53]

Charles White (1728-1813) wrote a book entitled An Account of the Regular Gradation in Man, and in Different Animals and Vegetables; and from the Former to the Latter (1779) which is equally as racist in its content as Long's work. From the title of his book it is obvious what White was up to. By comparing anatomical features of the Europeans and the Negroes, White was bent on proving that Africans are on a lower rung in the scale of being than Europeans. The following passages are typical of the kind of evidence he brought forth to justify this contention. "The SKIN, including the epidermis and rete mucosum, is well known to be thicker in the African than in the Europeans, and still thicker in monkeys."[54] "The HAIR of the head, chin, &c. is shorter and more woolly in the African than in the European, and still more so in monkeys."[55] "The RANK SMELL emitted

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[51] Ibid., p. 356.

[52] Ibid., pp. 358-62.

[53] Ibid., p. 375.

[54] Charles White, An Account of the Regular Gradation in Man, and in Different Animals and Vegetables; and from the Former to the Latter (London: Printed for C. Dilly, 1779), p. 57.

[55] Ibid., p. 58.

from the bodies of many negroes is well known; but it is much stronger in some tribes or nations than in others, and the strongest in apes."[56] "That the PENIS of an African is larger than that of an European, has, I believe, been shewn in every anatomical school in London. "In simeae the penis is still longer, in proportion to the size of their bodies."[57]

> I found with some surprise, that, the TESTES and SCROTUM are less in the African than in the European. They are still less, proportionally, in the ape. That the penis should be larger, and the testes and scrotum smaller, in the order thus stated is another remarkable instance of gradation.[58]

White used any source that furthered his contention that Africans were lower kinds of men that Europeans. He borrowed Charles Bonnet's version of the great chain of being;[59] he cited Thomas Jefferson (1743-1826) as an authority on the inferiority of the Negro's intelligence,[60] Petrus Camper (1722-1789) to prove the relatively poor shape of the Negro's skull,[61] and those parts of Buffon's work which indicate a hierarchy in the animal kingdom and seem to prove that the Negro is an intermediate species between the orangutan and the European type of man.[62]

While White and Long used Buffon's work on the apes to help

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[56] Ibid., p. 59.

[57] Ibid., p. 61.

[58] Ibid., pp. 61-62

[59] Ibid., pp. 15-16.

[60] Ibid., pp. 66-67.

[61] Ibid., pp. 50-51.

Ibid., pp. 30-39.

them prove the inferiority of Negroes, others used the Histoire to point out the inferiority of living things in America. Drawing heavily upon Buffon's Histoire, William Robertson (1721-1793), in his The History of America (1777), claimed that in the New World all living things -- except the lower forms of life, such as snakes -- are degenerates and are inferior to life in the Old World. Tapirs, the elephants of the New World, are no larger than six months old calves. The puma and the jaguar, American's fiercest beasts of prey, are cowardly.[63] "The bears, the wolves, the deer of America, are not equal in size to those of the Old World."[64] In general, the New World is "less favourable to the strength and perfection of the animal creation."[65]

Even though Robertson did not cite Buffon to any extent, the imprint of Buffon's work is all over his discussion of the American Indians. In a statement that appears to be straight out of the Histoire, Robertson asserted that the "beardless countenance and smooth skin of the American seems [sic] to indicate a defect of vigour, . . ."[66] But even worse, the Indian "is destitute of a sign of manhood and strength."[67] Thus, while the "negro glows with all the warmth

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[63]William Robertson, The History of America, 2 vols. (London: Printed for W. Strahan, T. Cadell, and J. Balfour, 1777), 1: 260.

[64]Ibid.

[65]Ibid., p. 261.

[66]Ibid., p. 290.

[67]Ibid., pp. 290-91.

of desire,"[68] the native Americans "treat their women with coldness and indifference."[69]

Many white Americans objected strenuously to Buffon and his European followers for asserting that the Indians and other forms of life in America are weaker and less vigorous than life elsewhere. Nobody objected more to the idea of an organically weak America than Jefferson. Jefferson stated that it was simply mistaken that all forms of life in America are smaller in size than their counterparts in Europe. And he provided the comparative sizes and weights of several kinds of animals common to both America and Europe to prove his point.[70]

Jefferson defended the American Indian with vigor. After quoting that part of the Histoire in which Buffon portrayed the Indian as a weak, unloving, cowardly, altogether miserable human being, Jefferson wrote: "An afflicting picture indeed, which, for the honor of human nature, I am glad to believe has no original."[71] But Buffon wrote from ignorance. The American Indian is "neither more defective in ardor, nor more impotent with his female, than the white reduced to the same diet and exercise: . . ."[72] He is not

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[68]Ibid., p. 292.

[69]Ibid.

[70]Jefferson, Notes on the State of Virginia, pp. 43-72.

[71]Ibid., p. 59.

[72]Ibid.

cowardly and "will defend himself against an host of enemies, always chusing to be killed, rather than to surrender, . . ."[73] He "is affectionate to his children, careful of them, and indulgent in the extreme: . . .",[74] and "his friendships are strong and faithful to the uttermost extremity: . . ."[75] The lack of bodily hair on Indians is not physical proof of their lack of virility. "With them it is disgraceful to be hairy on the body. They say it likens them to hogs. They therefore pluck the hair as fast as it appears."[76]

After diposing of Buffon's contention that native Americans are inferior, Jefferson then commenced to attack the Abbé Guillaume-Thomas François Raynal's (1713-1796) assertion that white America has produced no good poet, able mathematician or "one man of genius in a single art or a single science."[77] First stating that when America has existed as long as the ancient Greeks before they produced a Homer, Rome a Virgil, France a Racine and a Voltaire, and England a Shakespeare and a Milton, she might also add to the roll of illustrious poets, Jefferson then took issue with the idea that America has produced no men of renown. "In war we have produced a Washington, . . ."[78] "In physics we have produced a Franklin, . . ."[79] and we

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[73] Ibid., pp. 59-60.

[74] Ibid., p. 60.

[75] Ibid.

[76] Ibid., p. 61.

[77] Ibid., p. 64.

[78] Ibid.

[79] Ibid.

"have supposed Mr. Rittenhouse second to no astronomer living: . . ."[80]

The amount of effort Jefferson put into his refutation of the idea that American Indians are inferior human beings indicates something about the seriousness with which Buffon's ideas were taken. None of the authors just discussed, however, mentioned anything about Buffon's organic molecules, moules intérieurs, or penetrating forces. But this should not be too surprising. The moules intérieurs, organic molecules, and penetrating forces were all part of Buffon's comprehensive world view, in which he envisaged the formation, reproduction, and alteration of living things, including man, as manifestations of the timeless operations of universal physical forces. The people just discussed did not share Buffon's impulse to explain the formation of the human species and the causes of the human races in such a comprehensive manner. Their concerns regarding the human races stemmed from different, more narrow interests; consequently, whatever Buffon had to say on the matter of the production and perpetuation of life was of little importance to them. Their interests in Buffon's speculations on man were limited to the extent that these bore directly on the specific issues of race that interested them.

The manner in which Buffon's discussions of the human races were treated by the writers mentioned in this chapter may reflect general trends in natural history as well as the more specific drift of racial studies. Just as some naturalists of the early nineteenth century concentrated on trying to determine the essential physical and

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[80] Ibid.

mental distinctions among the various races,[81] the Buffonian style of natural history -- attempting to erect a global science of living things on fundamental characteristics of living matter -- faded and was replaced by the somewhat less bold but more rigorously empirical style of natural history epitomized in the morphological and comparative anatomical works of Georges Cuvier (1769-1832). The fate and influence of Buffon's theory of race among the new, nineteenth-century schools of anthropologists and biologists appears to be intertwined with this broad shift of focus in natural history.

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[81]Herbert H. Odom, "Generalizations on Race in Nineteenth-century Physical Anthropology," Isis 58 (1967): 5-18.

CHAPTER VIII

CONCLUSION

Buffon's work, particularly in regard to his explanation of organic variation, unfortunately has often been viewed through the distorting lenses of the nineteenth- and twentieth-century preconceptions and commitments. This unhistorical practice has characteristically led to the erroneous interpretation that Buffon was somehow a man outside, that is, before, his time. But any interpretation of Buffon's thought that aims toward historical cogency must view it in its eighteenth-century setting.

Operating upon the assumption that the categories of most systematists, but in particular those of Linnaeus, were based upon external characteristics which in no way could be shown to be the essential marks which distinguish plants and animals from one another, Buffon argued that the fundamental distinctions between different organic kinds and the real, that is, physical, relationships between individuals of the same kind were to be found in an examination of the reproduction of living things.

But Buffon rejected the reproductive theories of most

contemporary naturalists. He found the theory of pre-existence particularly odious. The idea that each succeeding generation of offspring was nothing more than the unfolding of preformed germs that had been encased one within the other by God did not, Buffon aruged, constitute a natural explanation of reproduction at all; it avoided the issue and merely put the whole matter in God's hands. In order to avoid what he thought to be the metaphysical character of the pre-existence theory, Buffon attempted to devise a theory of reproduction based upon what he took to be Newtonian principles.

In order to explain the processes of all living things, nutrition and growth as well as reproduction, Buffon stated that three essential factors are necessary: (1) organic molecules, (2) moules intérieurs, and (3) penetrating, attractive forces. Organic molecules constitute the bodies of organisms. Moules intérieurs, which are the forms of bodies, sustain and perpetuate organisms by organizing the organic molecules properly within living bodies. The penetrating forces are responsible for the incorporation of the organic molecules into the interior and external parts of living things.

With organisms which have a uniformity of organization throughout their bodies, reproduction can take place merely by the division of their bodies. Reproduction is not so simple in organisms with multiple parts. After a complex organism reaches its maturity, each of its organic parts sends to a place designed to receive them those organic molecules which beforehand would have been used for its growth. These molecules are reassembled and reunited by the same force which

penetrates all the different parts of living bodies. The new individuals will have a bodily form, that is, a moule intérieur, similar to their parents. In animals with sexes, the seminal fluids of the female must be mixed with those of the male in order for reproduction to occur.

A female and male are reproductively compatible only when the organic molecules from each of their parts have an affinity and will replicate a moule intérieur similar to their parents. The organic molecules of a cat are incompatible with those of a dog, for instance. Even if a cat and a dog were to copulate, they would never produce an offspring.

It is in the reproduction of like forms, which is assured by the moule intérieur, that Buffon found a definition of the species consistent with his criterion that physical entities (in this case living things) must have natural causes. Species cannot be caused by the abstract terms and categories of the systematists. The term species is only an abstract and general term which refers to the constant succession of similar individuals which reproduce.

Even in 1766, after he had acknowledged that environmental factors can alter the organic forms of the original prototypes to the point that different but similar species seemed to have stemmed from the same source, Buffon still did not reject the idea that the natural divisions in the living realm are marked off by the reproductive criterion. All of the species, no matter the alteration, which have stemmed from the same prototype have reproductively compatible moules intérieurs and constitute a natural genus.

Certain kinds of organisms are more prone to alteration than others; it all depends on the ability of the respective moules intérieurs of the different kinds of living things to impose organization upon the organic molecules. The moules intérieurs of lower types of life, such as insects, do not fix their organic forms on organic molecules nearly as strongly as do the higher types of life. Compared with the lower kinds of living things, there is hardly any variation in the human species. Between man and the lowest forms of life there exist all kinds of plants and animals with varying degrees of organic fixity.

No matter the amount of variation among individual plants and animals, the pattern to which individuals conform is timeless: given the same physico-chemical conditions the very same types of living things will inevitably appear. Events in the imperfect world of things may change individuals who are formed on these imprints, but the imprints themselves never change. It is incorrect, then, to think that Buffon was an evolutionist of the nineteenth- or twentieth-century sort.

Man, being the highest form of life, is less susceptible to variation than any other species. This is not to say, however, that the form of the human species has remained perfectly unaltered from the inception of man's formation. There have been groups of peoples who have degenerated. There have been other groups that have improved. Whether a people degenerate or improve depends upon the climate they inhabit, the food they eat, and their mode of living. People living in extremely hot or extremely cold climate are the most

degenerate specimens. Negroes, who live in the torrid zones, Laplanders, who live in arctic regions, and most American Indians, who live in the inferior New World, are all degenerate peoples. The white Europeans, since they live in the most favored climate, the temperate zone, are civilized, improved peoples.

As time passed, Buffon emphasized more and more the superior organic nature of civilized peoples compared to noncivilized, degenerate peoples. By 1778 Buffon had concluded that uncivilized peoples seemed forever doomed to be inferior to the white Europeans: their untamed environments have deleterious effects on the organic structures of uncivilized peoples. For example, uncivilized people are stupid and ugly. Because of their stupidity they are unable to improve their environment which in turn continues to harm them. The civilized peoples, being ingenious, are always devising ways to improve their environment, that is, mitigate what agents exist that cause degeneration, and consequently they are continually improving organically. One result is that they become increasingly intelligent. The gap between the civilized peoples and the uncivilized peoples thus is ever widening. How far removed from one another degenerate and improved peoples will become is a matter of conjecture.

While Buffon's speculations on the human races stimulated debates over the unity of man, the influence of environmental factors upon the human body and mind, and the relationship between apes and men, there is much to indicate that the theory he devised to explain organic variation within mankind died with him. Many prominent late eighteenth century writers on the human races simply did not mention

anything about organic molecules, moules intérieurs, or penetrating forces.

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