

AN ESSAY ON CLASSIFICATION

Agassiz on Evolution
Introduced by John M. Lynch
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Volume 1
Introduction
Louis Agassiz
An Essay on Classification (1859)

Volume 2
Louis Agassiz
Methods of Study in Natural History (1863)

Louis Agassiz

With an introduction by
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INTRODUCTION

The 1906 San Francisco earthquake caused a statue of the ichthyologist Louis Agassiz to plummet to the ground from the front of a building in Stanford University, embedding the statue head-first (but intact) in the courtyard below. Equally as famously, David Starr Jordan – President of the university and himself a former student of Agassiz – upon seeing this, is said to have observed that he had always thought better of Agassiz in the concrete than in the abstract.¹ If anything this event, occurring as it did early in the century that would see the solidification of Darwinism as an explanatory theory within evolutionary biology, offers a potent icon for the demise of special creationism as a major force within American intellectual life.

November 1859 is remembered as the month in which Darwin unleashed his theory of evolution through natural selection on a largely unsuspecting scientific community. Three months before, Agassiz published his *Essay on Classification* in London, and with it provided in book-length form not only a comprehensive, sweeping history and critique of hitherto known systems of classification, but also his strident renunciation of transmutationary systems.² While not explicitly *contra* Darwin, it would cogently summarize a system of thought that was directly opposed to Darwinian theories, synthesizing as it did aspects of *Naturalphilosophie*, natural theology, and Platonic idealism.³ It is this text that is reprinted herein. The remainder of this introductory essay will be concerned with briefly summarizing

¹ As it happens, Jordan did not make this quip. A 'Dr Argyll' expressed a preference for Agassiz in the abstract over the concrete. See Gould (1995).

² Mavr. describes the *Essay* as a 'truly breathtaking' survey of contemporary zoology (p. 181). For this reason, if no other, the work deserves the attention of historians of biology.

³ Further discussions of Agassiz's reactions to evolutionary thinking are provided by Mavr. Lurie (1960), Winsor (1976 & 1979), Gould (1979) and Morris (1997).

Agassiz's views, highlighting how he responded to Darwin and his supporters after 1859, and lastly examining the relationship between Agassiz and modern opponents of evolution. Agassiz was, in truth, the last special creationist with any notable scientific credentials, and while he never accepted either transmutation or natural selection, he left a mark on the institutional landscape of American natural science.⁴

Louis Jean Randolph Agassiz was born in Switzerland on 28 May 1807.⁵ The son of a Protestant preacher, he studied in Zürich and Heidelberg before typhoid forced his return to Switzerland in 1826. The following year, he began studies in Munich which resulted in his exposure to the scientific theories of Konrad Oken and Ignatius Döllinger, and the Romantic philosophy of Friedrich Schelling.⁶ It is during this period that he began his *Fishes of Brazil*, a work that would bring him to the attention of the famed comparative anatomist Georges Cuvier. Receiving the Ph.D. in 1829 and the MD the following year, Agassiz moved to Paris where he began work on *Poissons Fossiles* (Fossil Fishes) using material given to him by Cuvier. (In 1857 he would be offered – and would decline – the chair of paleontology at Musée d'Histoire Naturelle de Paris). Agassiz's peripatetic existence would continue as he returned yet again to Switzerland as Professor of Natural History at the Lyceum at Neuchâtel, where he would remain for fourteen years. This period of his life saw Agassiz complete the majority of the research for which he rightly received fame as a paleo-ichthyologist. His fame spread, and in 1846 he was invited to speak at the Lowell Institute in Boston. This in turn led to his appointment as a professor at the Lawrence Scientific School of Harvard University in 1847, a

post he retained until his death on 14 December 1873. While this latter period of Agassiz's life was not marked by the productivity of his European years – he more often than not failed to complete projects – it saw Agassiz become a major influence on the development of American scientific culture.

The key to understanding Agassiz's writings is to remember that, above all else, he was European and greatly influenced by the Romantic themes within nineteenth-century European thought; he believed that the Romantic view of nature as a whole was validated by the methodology of Cuvier.⁷ As Lurie has noted, Agassiz 'did embrace the Protestant pietism of his minister father, but was more fundamentally devoted to an idealistic romanticism that saw the power of the Creator exemplified in all flora and fauna.'⁸ His science, in turn, was a mixture of the empirical framework of Cuvier and aspects of the romantic *naturphilosophie* and idealism of Oken and Schelling with which he dallied as a young man. While Mayr has highlighted this idealistic component of Agassiz's thought as the reason for his rejection of evolution, others have noted that other idealists accepted a saltative form of transmutation and suggested that it was actually the observed fixity of modern forms and taxonomic categories that shaped his views.⁹ Agassiz was interested in pattern rather than causation, believing that once one accepted the naturalness of the classifications he proposed, one must see that these were merely translations of the thoughts of the Creator into the language of the scientist. This influence of Neoplatonism and Romanticism also hints that Agassiz's opposition to transmutation was rooted more in transcendental philosophy than Christian theology; as Jim Moore cogently points out, '[t]he anti-Darwinian element in Christian Anti-Darwinism may thus have little to do with Christian doctrines.'¹⁰ Indeed, while Agassiz insisted that his conclusions were grounded in observation, this metaphysical idealism learned in Europe probably was responsible for Agassiz's views even more than any research. It would be difficult to improve upon Ernst Mayr's conclusion: 'Agassiz's

⁷ Moore, p. 207.

⁸ Lurie (1960), p. 72.

⁹ Winsor (1979). See also Bowler, p. 128.

¹⁰ Moore, p. 215.

⁴ In fairness there is, to this day, a small, but vocal, number of individuals who support special creationism (the conviction that God created the universe, including humans and other living things, by direct action at one time in the relatively recent past). None of these approach the scientific achievements of Agassiz, or for that matter, those of any of the great scientists of the past who they proclaim as 'Bible-believing Christians' and Creationists. As we will see below, the epithet of 'Bible-believing' is problematic even when applied to the pious Agassiz.

⁵ Details of Agassiz's life and writings are provided in E.C. Agassiz, Marcou, and Lurie (1960).

⁶ Ruse discusses the influence of *Naturphilosophie* and Neo-Platonism on Agassiz's thought (pp. 111–17).

misfortune was to have absorbed in his youth a *Zeitgeist* that was unsuitable for mixing with the revolutionary new ideas. He was, one may say, a victim of the thoroughness of his education.¹¹

While Agassiz was European by birth, he was American by choice. Paralleling the views of many immigrants, he saw America as a land of great opportunity and moreover a place where he could help formulate a new natural history. As part of this project he wanted to write a series of monographs with the aim of instructing the American public in natural history, and in 1855 he began a subscription campaign for the planned ten-volume *Contributions to the Natural History of the United States*. Only three volumes ever appeared: richly illustrated folio editions discussing turtles, Radiata, and Acalephae. Support came from expected sources, with Alexander Von Humboldt and Richard Owen – himself somewhat of an idealist – expressing their delight at the work. However, the *Contributions* was too complicated for the public and lacked a theoretical framework that satisfied the specialists. As Winsor points out, 'there was not as much of a division of opinion among naturalists, however, as a stunning silence, suggesting unanimous inability to make a concrete sense of Agassiz's category definitions.'¹²

It is the first part of *Contributions* that interests us here. The first volume was prefaced with an extensive *Essay on Classification*, and all parts subsequent were intended to illustrate the arguments made therein. The *Essay* forms a unified examination of Agassiz's views on biological classification, and successive writings little modified his statements. Briefly put, Agassiz saw natural history as the discovery of the thoughts of the Creator. Species were fixed, unchanging entities that had a Platonic reality. Large numbers (not a biblical pair) of each species were created in the habitats that the Creator intended them to inhabit, and there was no common descent of species from either Eden or Ararat.¹³ The Ice Age – for Agassiz was the one who developed the theory of glaciation – was initiated by the Creator as a barrier between the 'prophetic' species of the past

and those of the present. There was thus no genetic connection between the species across time, and there was 'a complete break between the present creation and those which precede it; if the living species of our times resemble those buried in the levels of the earth, so as to be mistaken for them, it cannot be said that they have descended in direct line of progeniture, or what is the same thing, that they are identical species.'¹⁴

Through all of this, Agassiz remained true to Cuvier's vision of nature. He accepted the four Cuvierian *embranchements* – Vertebrata, Insecta, Vermes, Radiata¹⁵ – as being real and noted that he was 'daily more satisfied that the primary divisions of Cuvier are true to nature and that never did a naturalist exhibit a clearer and deeper insight into the most general relations of animals than Cuvier'.¹⁶ Adopting a Cuvierian catastrophism, Agassiz felt that after each catastrophe, new species appeared. The Biblical Flood was only one such catastrophe, while the last was the Ice Age with its glaciers which formed instantaneously world-wide. Other catastrophes would surely occur in the future. Yet despite these upheavals, Nature shows 'not only thought, it shows also premeditation, power, wisdom, greatness, prescience, omniscience, providence. In one word, all these facts in their natural connection proclaim aloud the One God, whom man may know, adore and love; and Natural History must in good time become the analysis of the thoughts of the Creator of the Universe'.¹⁷ Above all else, it is clear that the ideas contained within the *Essay* represent a clear form of natural theology. Agassiz's God was 'a busy, imaginative, enthusiastic, benevolent God with a love of form and order, a concern for detail, an appetite for variety, a passion for progress, an eternal readiness to start fresh.'¹⁸ Like his English counterpart, Adam Sedgwick, Agassiz's real fear was deism – a Creator who ruled through law

¹⁴ Marcou, Vol. I, p. 107.

¹⁵ The Cuvierian *embranchements* were finally disrupted in 1848 when Rudolf Leuckart proposed that the echinoderms (starfish & urchins) should be dissociated from the coelenterates within the Radiata. This suggestion was rapidly accepted by the scientific community. Thus, writing in 1857, Agassiz was more than a little behind the times. See Winsor (1976), p. 128 *passim*.

¹⁶ Agassiz, 1859, Chap. II, Section I.

¹⁷ Agassiz, 1859, Chap. I, Section XXXII.

¹⁸ Bruce, p. 30.

¹¹ Mavr, p. 193.

¹² Winsor, 1991, p. 27.

¹³ Numbers, p. 28.

and was content to let His creation function without providence. These observations aside, the *Essay* should not be seen as some form of primarily theological or philosophical work. Agassiz clearly felt that the volume would aid in training students to discover patterns in the natural world. Writing to Spencer F. Baird, the curator of the Smithsonian collections, he would state:

The results are so practical that even my students of one year standing with the rules are able to trace for themselves ... the natural limits of genera and families and they actually do it better than our old practiced Zoologists. So you see it will tell in the progress of science.¹⁹

Central to Agassiz's claim of utility was his belief that he had discovered true definitions for the various taxonomic categories (*embranchments*, classes, orders, families, genera and species). However, as Winsor points out, Agassiz's definitions were not only vague but 'useless and empty' and his work received little professional support.²⁰

The London edition of 1859 (reprinted here²¹) appeared as a separate volume at the instance of such well-known anti-Darwinists as Owen and Sedgwick, three months before the publication of *Origin*. As Lurie has noted, there can be no sharper contrast between the two concepts of evolution and special creation than that portrayed by these two works. Working from similar data, the two authors drew radically different conclusions, a fact that Agassiz himself would acknowledge in 1874 when he wrote that the 'facts upon which Darwin, Wallace, Haeckel and others base their views are in the possession of every well-educated naturalist. It is only a question of interpretation, not of discovery of new and unlooked-for information.'

Naturally, Agassiz responded directly to Darwin. At a Boston Society of Natural History meeting, Agassiz dismissed Darwin's

theory as being 'ingenious but fanciful', directly falsified by the persistence of type within the fossil record. He would follow this with a review in the *American Journal of Science and Art*.²² In the latter, he stated that 'species are based upon relations and proportions that exclude ... the idea of common descent.'²³ Mechanism was not the issue – while Darwin sought to explain the common descent of organisms, Agassiz felt that such a pattern was a product of the Creative mind rather than of a naturalistic process. Darwin's view was thus 'a scientific mistake, untrue in its facts, unscientific in its method, and mischievous in its tendency'.²⁴ This review was the last occasion when he discussed transmutation in a professional forum, as all subsequent discussions occurred in a popular form. Indeed, *Methods of Study in Natural History* (first published in 1863 and going through twenty-one editions up to 1893) stemmed from a series of lectures on his *Essay* that Agassiz gave at the Lowell Institute. While personally rejecting Darwin, he was at the same time encouraging his students to read *Origin*, stressing how Darwin had 'deserted the inductive method'. His students appear to have read Darwin's work in the early 1860s with 'no notable effect'.²⁵ However, by the time of Agassiz's death in 1873, most of his younger students were evolutionists (if not Darwinists). In the words of Edward Morse – himself a student of the master:

Agassiz's earnest protest against evolution checked the too-hasty acceptance of this theory among American students. But even the weight of his powerful opposition could not long retard the gradual spread of Darwin's views: and now his own students, the last to yield, have, with hardly an exception, adopted the general view of derivation as opposed to that of special creation.

The 1869 French translation of *Essay* permitted Agassiz to add three sections to the original work: a discussion of sexual dimor-

¹⁹ Quoted in Winsor, 1991, p. 20.

²⁰ Winsor, 1991, p. 21.

²¹ This edition is the one presented in Lurie (1962); however, that version is neither a facsimile nor presents all of Agassiz's bibliographic footnotes. Agassiz used the opportunity to make some minor emendations and additions to the original work; in particular he provided additional bibliographic resources.

²² Meeting of February 15 1860; Quoted in Numbers, p. 31.

²³ Agassiz (1860), p. 143.

²⁴ Agassiz (1960), p. 154.

²⁵ Winsor, 1991, p. 38.

phism, one of 'primitive' humans, and lastly a discussion of Darwinism. This last addition allowed Agassiz to offer an explicit critique of Darwin's theory, particularly concentrating on Ernst Haeckel's classificatory system. This critique repeated Agassiz's marginal comments on his copy of Haeckel's *Natürliche Schöpfungsgeschichte* ('Natural History of Creation') of 1868. For his part, Haeckel had little time for the *Essay*, supporting as it did the 'absurd anthropomorphic doctrine of a Creator'.²⁶ In his comments, Agassiz offered a consistent attack on the speculative inferences of Haeckel regarding the fossil record.²⁷ Once again, Agassiz rehearsed familiar themes: Darwinists were accused of putting their philosophy before facts, variation had distinct limits, and the fossil record was inconsistent with Darwinian expectations. The first of these accusations remains popular to this day, and Agassiz's words could have been penned by a modern opponent of evolution:

Darwinism excludes nearly all the mass of acquired information, for it assimilates and takes exclusively that which could be useful to the Doctrine. It is not the facts that determine for the Darwinists the nature of their generalizations, it is the system that dictates the nature of their reality.²⁸

Five years later, in a posthumously published account, he wrote:

The most advanced Darwinians seem reluctant to acknowledge the intervention of an intellectual power in the diversity which obtains in nature, under the plea that such an admission implies distinct creative acts for every species. What of it, if it were true? Have those who object to repeated acts of creation ever considered that no progress can be made in knowledge without

²⁶ Haeckel in 2nd (1873) edition of *Natürliche Schöpfungsgeschichte*, quoted in Hodge, p. 113.

²⁷ Gould (1979) discusses these marginalia and provides ample evidence of Agassiz's disgust at Haeckel's pronouncements. For example, at various stages he writes 'Haeckel ist der Apostel', 'Behaupten is nicht Beweisen' [To assert is not to prove], 'Abscheulich' [Disesteable] and he ends his comments with 'Gegben in Jahre 1 der neuen Weltordnung. E. Haeckel.' Agassiz was clearly not impressed!

²⁸ Agassiz (1869), p. 377, quoted in Morris (1997), p. 126.

repeated acts of thinking? And what are thoughts but specific acts of the mind? Why should it then be unscientific to infer that the facts of nature are the result of a similar process, since there is no evidence for any other cause?²⁹

Both of these charges are currently being rehearsed – despite refutation by philosophers, historians and biologists – by such gadflies of evolution as Philip Johnson, William Dembski, and Jonathan Wells. Over 125 years later, the buzzing and biting continues, yet the horse that is Darwinism continues to prove its merit. Chauncey Wright commented that *Origins* rendered 'Agassiz's essay on classification a useless and mistaken speculation; creation is a word pretending knowledge and feigning reverence', and the same is true for modern pleas to 'Intelligent Design Creationism'.³⁰ Like modern creationists, Agassiz could not accept transmutation until it was shown that 'any well known species among the many thousands that are buried in the whole series of fossiliferous rocks, is actually the parent of any one of the species now living', ignoring the obvious point that even the most perfect transitional series could be interpreted as an unfolding of a pre-ordained plan.³¹ What was, and still is, required was *positive scientific* evidence for the actions of the Creator, an enterprise that theologians admit is an intellectual minefield.

In the *Essay*, Agassiz had noted that the gradation within any taxon parallels (a) the order of appearance in the fossil record, (b) the ontogenetic stages through which the organism moves as it grows, and (c) the latitudinal distribution of the taxon, such that the 'lowest' forms were found lowest in the fossil record, earliest in embryonic development, and at the highest latitudes. This observation had been predated by the 'triple coincidence' of 1854. This parallelism between paleontology, comparative anatomy and embryology ('plan upon which animals shall vary in their structure over time'; 'order of gradation of structure of living beings'; and 'order of growth of the young animal from the egg') pointed towards an Intelligence, for just as '[w]e recognize

²⁹ Agassiz (1874), p. 101.

³⁰ Quoted in Marcou, Vol. II, p. 110.

³¹ Agassiz (1860), p. 144.

and analogy, it remained weak in several areas – notably the empirics of the fossil record.³⁷ Haeckel was particularly problematic; inspired by an evolutionary *Weltanschauung*, he used deceptive rhetoric and fraudulent illustrations to bolster the case for his particularly virulent anti-theism.

Agassiz's biographer, Jules Marcou – who as a young geologist was supported by Agassiz – launched a spirited defence of his mentor in 1896. Dividing scientists into 'philosophical naturalists' and 'pioneer-naturalists' (those 'guided by well-observed facts'), he placed Lamarck, Geoffroy St-Hilaire, Darwin, William Bates and Alfred Russel Wallace in the former category, noting that [d]uring their long isolation, naturalist-philosophers are apt to theorize. Needless to say, Agassiz was in the latter category; as a 'pioneer-naturalist' he worked in laboratory and field, observed 'without prejudice', and was 'disinclined to theorize, until all facts lead [him] toward an inevitable conclusion'.³⁸ Such individuals were responsible for 'all true and solid progress ... and without them natural history could hardly be comprehended.' This quasi-Baconian view of science receives support – unsurprisingly – from modern creationists who see Agassiz as an intellectual forefather, a 'founding father of modern science' and 'Bible-believing creationist'.³⁹ The latter phrase, used by Biblical literalists for each other, is clearly fallacious when applied to Agassiz, as even the most cursory examination of his theory of creation would show. Agassiz was no literalist, and in April 1860, a student of Agassiz noted that he had lectured on 'the absurdity of believing that Adam and Eve were the first created and the only ones'. He debated against dogmatic inter-

³⁷ Gould (1979), p. 278. As Ruse clearly shows, evolutionary theory became increasingly more objective and observation-driven as the synthesis of the early twentieth century took hold. While modern anti-evolutionists often claim that the field is driven by extra-epistemic factors, philosophers of biology are confident of the scientific status of the investigations.

³⁸ Marcou, Vol. II, pp. 103–128, particularly 112ff. Marcou saw Richard Owen, Georges Cuvier and 'almost all' paleontologists to be 'pioneer-naturalists'. He furthermore claimed that Charles Lyell did 'not in the least change the face of geology', while he, Joseph Hooker and Asa Gray 'constantly applied lawyer's methods to natural history. No one of them possessed the naturalists spirit and turn of mind'. Marcou had particular reason for supporting Agassiz so stridently; see Lurie (1960), pp. 271–75.

³⁹ Morris (1974), p. 14; Huse (1997), p. 157; See also, Morris (1993), p. 29.

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intelligence in the construction of a machine because we know that it could not operate in the manner it does were it not the device of an intelligent artisan ... the animal kingdom especially has been constructed upon a plan which presupposes the existence of an intelligent being as its Author'.³²

Agassiz's last thoughts on transmutation and Darwinism were presented in a posthumously published essay in *Atlantic Monthly*. Written as the introduction to a projected series of essays,³³ it paleontologist reiterated many of his previous arguments.³³ It may appear somewhat surprising that Agassiz declares it 'unquestionable' that evolution occurs in nature.³⁴ This in no way contradicts his anti-transmutational stance, as one must remember the original meaning of the word 'evolution' was a preordained unfolding of a plan. Thus, embryos evolve into their adult forms, preserving the essence of the type. Whenever Agassiz used the term 'evolution' it was in this sense, and this embryological perspective offered him another way to criticize Darwin, who 'would have us believe that it required millions of years to effect any one of these changes; when far more extraordinary transformations are daily going on, under our eyes, in the shortest periods of time, during the growth of animals.'³⁵

In all fairness to Agassiz, some of his objections to evolutionary thinking were not without merit. Early evolutionary theory – particularly that to which Agassiz would have been exposed during his school years – was largely a product of arm-chair speculation; Mayr points out that Jean-Baptiste Lamarck, 'by far the most erudite evolutionist of the period', finished his evolutionary speculation before his research on invertebrates.³⁶ This was to hold true for much of the century; Gould notes that evolutionary theory during the mid-nineteenth century was not 'a firm, deductive argument that could only be opposed by theistic dogmatism. As a world view, embedded in metaphor

³² Agassiz (1866), pp. 71, 78.

³³ Agassiz (1874); this essay has also been republished as Agassiz (1894) and Agassiz (1973).

³⁴ Agassiz (1874), p. 92

³⁵ Agassiz (1860), p. 146.

³⁶ Mayr, p. 167.

pretations of Scripture, and for this was respected by many.⁴⁰ Writing to Adam Sedgwick, he would opine:

I dread quite as much the exaggeration of religious fanaticism, borrowing fragments of science, imperfectly, or not at all, understood, and then making use of them to prescribe to scientific men what they are allowed to see or to find in nature.⁴¹

What is striking to note is that Agassiz's literalism was clearly not biblical – he after all accepted multiple creations. However, he strongly believed that *nature* should be treated literally, i.e. that all scientific evidence was to be accepted at face-value and that theoretical interpolations – especially between strata – were not to be countenanced.

If anything, Agassiz shared his wife's Unitarianism and thus denied the divinity of Jesus.⁴² Ironically, it was Asa Gray – the supporter of Darwin – who was a Calvinist and evangelical.⁴³ Agassiz's theory of a never-ending creation clearly conflicted equally with a literal Biblical reading as much as did Gray's vision of a universe created with the potential to generate a multiplicity of forms. Just before his death, Agassiz confided that he would 'have been a great fellow for evolution if it had not been for the breaks in the paleontological record'.⁴⁴ For Agassiz, the Bible was not a textbook of science, and arguments against evolution had to come from nature not dogma.

It has been commented that Agassiz's American researches never fully reached the potential of his early European studies. As a young man, his ichthyological, paleontological and geological investigations brought him to the attention of Cuvier and von Humbolt. While in America, his projects often went unfinished, and in his later life, Agassiz was a more of a public man of

⁴⁰ Quoted in Winsor, 1991, p. 8; Lurie (1960), p. 262.

⁴¹ Letter to Adam Sedgwick, June 1845, see E.C. Agassiz, Vol. I, p. 388.

⁴² A point conveniently ignored by creationist writers on Agassiz who also ignore his clearly stated racism as they attempt to tie Darwinism with racism. For the former see Lurie (1954), for the latter, Bergman (1993), Humber (1997), Morris (1973).

⁴³ Moore, p. 271.

⁴⁴ Numbers, p. 28

science than a researcher. During this phase of his career, his actions were often more driven by political considerations than epistemological concerns. Yet Agassiz's contribution to science in general, and American science in particular, should not be underestimated. Marcou, writing in 1896, noted that

In fifty years, our successors will be in a better position to form a judgment. The records of a Cuvier and of an Agassiz, with their admirable works on classification, comparative anatomy, palaeontology embryology, glacial doctrine, can await the test of time.⁴⁵

By 1946, Darwinism was ascendant, but it would be mistaken to ignore what Agassiz achieved. His paleo-ichthyological studies and taxonomic work stand to this day, while his glacial theory took much of the steam away from Biblically-inspired attempts to explain geology. He pioneered the use of multiple forms of evidence for classification without reference to any process of evolution – a method advocated by today's cladistic school of classification. As he noted in the *Essay*;

Classification seems to me to rest upon too narrow a foundation when it is chiefly based on structure. Animals are linked together as closely by their mode of development, by their relative standing in their respective classes, by the order in which they have made their appearance upon earth, by their geographical distribution, and generally by their connection with the world in which they live, as by their anatomy. All these relations should, therefore, be fully expressed in a natural classification; and though structure furnishes the most direct indication of some of these relations, always appreciable under every circumstance, other considerations should not be neglected which may complete our insight into the general plan of creation.⁴⁶

In addition, he popularized the study of nature among the American public, and was a teacher and mentor to Alpheus

⁴⁵ Marcou, Vol. II, p. 125.

⁴⁶ Agassiz (1859), Chap. I, Section XXXII.

Hyatt, David Starr Jordan, Joseph LeConte, Alpheus Packard and Alexander Agassiz, all of whom would go on to contribute to American natural history.⁴⁷ He was influential in the formation of the American Association for the Advancement of Science and the National Academy of Science. Yet, in many ways, Agassiz's most lasting legacy was realized in 1859, as it was in this year that the Museum of Comparative Zoology was founded at Harvard.⁴⁸ Under Agassiz's guidance – and later that of his son, Alexander – the MCZ became a major centre for biological and paleontological research in America. Funded by public and philanthropic monies, it has provided graduate instruction, research opportunities and a home for many prominent natural scientists. Yet herein lies a bitter irony. While perhaps built as a 'fortress against evolution', the MCZ has become a virtual temple of evolutionary biology and Darwinism. It is within these walls that Ernst Mayr proved so influential in the development of neo-Darwinism, that E.O. Wilson developed the field of sociobiology with its application of Darwinism to social behavior in man, and that Stephen Jay Gould popularized Darwinism among the American public while provoking reaction from the scientific community with his replies to both Wilson and 'Darwinian fundamentalism' and his advocacy of his theory of punctuated equilibrium. The spirit of Agassiz has clearly been shown to be longer-lived in the physical concrete of the MCZ than in the abstract of his anti-evolutionary writings.⁴⁹

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⁴⁷ Ironically, prodded by Agassiz's encouragement to question all and see for themselves, they became evolutionists, yet maintained a certain *natural-philosophie* which allowed for parallelisms, *baupläne* and such like.

⁴⁸ Winsor (1991) provides a fascinating and entertaining history of the MCZ and its inhabitants, while also demonstrating the importance of the ideas contained in the *Essay* to the success of Agassiz's campaign for public funding for the museum. Ironically, it was in November – as *Origin* was being printed – that Agassiz and his students moved into the MCZ.

⁴⁹ I would like to thank Philip de Bary for his patience and Jacques Lynch for editorial assistance. *In memoriam* Les Marcus, teacher and friend.

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