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Young Darwin: The Maturation of a Romantic Scientist

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ABSTRACT

YOUNG DARWIN: THE MATURATION OF A ROMANTIC SCIENTIST

by

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The "Beagle" voyage is viewed as Darwin's apprenticeship to the guild-like scientific community of 1830's England. In the course of the five-year voyage, Darwin was transformed from an amateurish nature enthusiast into a formidable natural scientist with a publishable theory on coral reef formation. His maturation is viewed within the framework of John Herschel's program for the advancement of the sciences, and in terms of his relationship to his mentor, John Henslow. Darwin's maturation also contained a Romantic dynamic, as his worldview was influenced throughout the voyage by the Personal Narrative of the German Romantic Scientist, Alexander von Humboldt. The Romantic aspect of Darwin's scientific outlook is then placed in the context of the scientific community to which he was aspiring. All of Darwin's writings (diary, letters, notebooks) from the period 1831-1836 were used in the research.

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Key to Abbreviations of Frequently Used Sources

BD: The Beagle Diary, by Charles Darwin ed. Richard Darwin Keynes, 1988.

CP: The Correspondence of Charles Darwin, vol. 1, 1821-1836. eds. Frederick Burckhardt and Sydney Smith, 1985.

PN: Personal Narrative of the Travels to the Equinoctial Regions of the New Continent during the years 1799-1804, by Alexander von Humboldt and Aimee Bonpland, 3 vols., ed. and translated from French by Thomasina Ross, 1881.

PD: Preliminary Discourse on the Study of Natural Philosophy, by John F. W. Herschel, 1831.

RN: The Red Notebook of Charles Darwin, ed. Sandra Herbert, 1980.

INTRODUCTION

In April of 1831, the spring of his graduation, Charles Darwin was trying to generate interest within his social network at Cambridge, which included professors and other students interested in naturalizing, for a scientific excursion to the Canary Islands. "At present, I talk, think, & dream of a scheme I have almost hatched of going to the Canary Islands. - I have long had a wish of seeing tropical scenery & vegetation: & according to Humboldt Tenerife is a very pretty specimen," he told his cousin and close friend, W. D. Fox.(CP, 120)[1] In preparation for this projected trip, he spent the next few months reading and rereading the Personal Narrative[2] of the German naturalist Alexander von Humboldt, and took a crash course in field geology by way of a three-week expedition in Wales with Cambridge geology professor Adam Sedgwick. But just as Darwin realized that he was the only one among his friends genuinely committed to the idea of a voyage to the Canary Islands and that the trip would never materialize, John Henslow, Darwin's mentor, presented the opportunity to join the H. M. S. Beagle as a personal guest of her captain, Robert Fitzroy. In the last week of 1831 the "Beagle" set sail.

Darwin left England an enthusiastic naturalist with a particular affinity for the Romantic style of nature

description of Alexander von Humboldt, but with little experience in formal scientific inquiry. Over the course of the next five years, however, as Captain Fitzroy led the "Beagle" on an expedition to chart the waters around South America, Darwin emerged from an amateurish nature enthusiast into a formidable natural scientist who had gathered data in all the branches of natural science, exhibited some expertise in geology, and had a publishable theory on the formation of coral reefs. How did Darwin become transformed into this mature scientist, who was ready to join the ranks of the guild-like scientific community in England? What implications did this transformation have on his earlier affinity to the Romantic style of Humboldt?

To my knowledge, Darwin's scientific maturation during the "Beagle" voyage has been little explored.[3] The period of the voyage, December 1831 - October 1836, has typically been used in Darwin scholarship as a prelude to his monumental work later in life. In "The Discovery of a vocation," James Secord has discussed Darwin's conversion to Lyellian geology while in South America. Others have attempted to describe the development of his theory of evolution, and highlighted his observations of variant species in the Galapagos Archipelago and the years of study immediately following the voyage as the crucial time when he began seriously to question the generally accepted creationist view.[4] Michael Ruse has described the complex

combination of factors, (Lyellian geology, the Galapagos experience, and the context of early Victorian science), that contributed to the "Darwinian Revolution." However, there seems to be very little detailed analysis of Darwin's development within the time boundaries of the voyage itself, and perhaps no recognition of a potential Romantic twist to Darwin's worldview in the 1830's.

This period was Darwin's apprenticeship in the craft of performing science. He began it at the age of twenty-two, with enormous enthusiasm but little practical experience in formal scientific investigation. Upon his return, Darwin was a competent gatherer of data for a wide variety of natural phenomena and an accomplished geologist. My interpretaiton is that Darwin's intellectual development represented a synthesis of his early affinity for the Romantic science of Humboldt with the hypothetico-deductive method of scientific inquiry, as articulated by John Herschel, which he acquired during the voyage.

Darwin boarded the "Beagle" with Humboldt's travel narrative in hand. He found in it the inspiration to engage a five year journey and the sensibility of a man whose view of nature resonated with his own. Humboldt, along with Goethe and Schelling, helped to shape the German Romantic movement in its critique of the tradition of the Newtonian/Baconian Enlightenment, which, in their perception, lacked sufficient attention to the subjective

consciousness of the naturalist in nature. Humboldt's contribution to the Romantic response was literary, for he believed that the truths of nature could only be revealed by the poetic rendering of one's experience of his scientific investigations. The central element of Humboldtian Romantic Science was the essential oneness and unity of nature which includes the observer. Darwin continually read the Personal Narrative throughout his journey and even imitated Humboldt's style of nature description in the writing of his own diary. He maintained his conviction throughout the voyage to the essential element of Romantic Science, as exemplified by Humboldt, which insists that nature description must contain the subjective experience of the observer.

Darwin also brought on board the "Beagle" Herschel's A Preliminary Discourse on the Study of Natural Philosophy,[5] and his own intellectual development would parallel the tenets therein. Herschel's hypothetico-deductive method, which was an expansion of the Baconian vision of scientific investigation, set forth a scheme for the advancement of science in general. Herschel's method requires that every naturalist achieve expertise in a particular branch of science by the inductive process of attaining general principles, via thorough data collection, and then apply those principles to other branches of science. By applying a theory derived in one branch of science to another, the

sensitive investigator (according to Herschel's scheme) could test the universality of his theory by deducing anticipated phenomena of another branch of science, prior to actually observing them. Thereafter the naturalist should approach subsequent investigations with a critical eye, looking for the crucial data to support or refute his theory.

Darwin was well disposed to follow this Herschelian program during the voyage. Already a collector and observer in a variety of branches of sciences, he had developed general familiarity with a wide scope of phenomena as a youth and undergraduate at Cambridge. On the voyage itself he gained particular expertise in geology with the help of the new theory of gradual land formation advanced by Charles Lyell. Lyell's theory was, at the time of Darwin's departure from England, highly controversial, largely speculative and in need of testing in new environments. In his early geological observations on the voyage, Darwin tested the effectiveness of Lyell's theory in explaining the geological features in South America. Darwin eventually became a convinced Lyellian, and during the latter part of the voyage, he began to speculate (with some success) on how coral reefs might have been formed, based on Lyell's principle of gradual land upheaval and subsidence. Such zoological hypothesizing about the unseen, on the basis of known geological principles, is a classic example of

Herschel's hypothetico-deductive method. As such, Darwin's scientific development occurred within the framework of Herschel's conception of what is required of mature scientific investigation.[6]

* * *

In addition, I interpret Darwin's intellectual development in the context of the scientific community to which he was aspiring as he left the "Beagle" in the Fall of 1836. His maturation within the Herschelian framework did not bring about a rejection of Humboldtian Romantic principles. Robert Preyer has persuasively argued that the leaders of that community were also influenced by Romantic principles.[7] The generation of Darwin's professors had, in their younger days, participated in a flowering of scientific culture with a perspective that adhered to principles of Romanticism, while rejecting the early forms of Benthamite Utilitarianism (Preyer, 42). Since Herschel, Sedgwick, Whewell, and Henslow maintained a scientific vision inclusive of Romantic elements, then it is understandable why Darwin came to share that vision while at Cambridge. In fact, it was Henslow who had first recommended that he read Humboldt. My interpretation of Darwin's science on the "Beagle" builds on Preyer's argument

that the generation prior to Darwin's manifested a trend within English science during the 1820's and 1830's, when Romantic principles were incorporated within the dominant worldview.

At the end of the voyage Darwin's view of science still contained an essential Romantic principle, that scientific study should express the scientist's intimate connection the object of one's study. In the final entry of his shipboard diary, Darwin attempted to reflect and draw some conclusions about the voyage. He recalled his first encounters with the scenery of the tropics, particularly the "sublimity of the primeval forests," which were permanently impressed upon his mind. "No one can stand unmoved in these solitudes, without feeling that there is more in man than the mere breadth of his body" (Beagle Diary, 444).[8] Darwin refers to a spiritual, extra-corporeal dimension of which he was acutely aware in the presence of sublime nature. His decidedly unmaterialistic view parallels the Humboldtian Romantic science focus on the subjective experience of the natural world.

Darwin's Humboldtian Romantic perspective, so clearly articulated at the end of the voyage, was a significant part of his outlook in the early stages of the voyage. During the first few months in the tropics, Darwin relied heavily on Humboldt's Personal Narrative to inform his perceptions. His Diary is dominated by descriptions of the awe and

sublimity he experienced. For example, in the second month of the voyage, when he was overwhelmed by the beauty of tropical vegetation in Brazil, Darwin was "fit only to read Humboldt; he like another Sun illumines everything I behold" (BD, 42). Darwin considered Humboldt's descriptions unparalleled for he was the "rare union of poetry with science" (BD, 42). Such high praise and reverence implies that Darwin believed Humboldt was an example of a good naturalist. From the early going, Humboldt was someone he would strive to emulate, and he used the Personal Narrative as means by which to experience his first encounters with the tropics as a Romantic Scientist.

Darwin was not the only person of his time to be touched by German Romantic thought. Preyer argues that the "Romantic tide" of the early nineteenth-century also influenced many other undergraduates at Trinity College, Cambridge. Connop Thirlwall and Julius Hare, intimate friends of Samuel Taylor Coleridge, were crucial, as tutors during the 1810's, for exposing the young minds of Trinity to Romanticism. These men cultivated an ardent interest in German Idealism and infected the undergraduates with their animated rejection of utilitarianism. While Thirlwall and Hare are the central figures in Preyer's analysis, Herschel, Henslow, Sedgwick, and William Whewell, figure prominantly as well--and Darwin had contacts (one way or another) with all of these latter men.

Whewell, an 1816 graduate of Trinity and later, Professor of Minerology and eventually master of the college, was a major spokesman in the scientific community when Darwin was an undergraduate, who wrote on the history and philosophy of inductive science (Ruse, 22). Preyer describes Whewell as a leader in the idealist rejection of Benthamite Utilitarianism and that he was particularly suited to do so because he was one of few Englishmen who read and understood Kant, Fichte, Schelling and Hegel in German. This unique ability, according to Preyer, is owing to the Romantic legacy at Trinity (Preyer, 45).

Whewell's notion of how to create scientific knowledge involved a balance between empirically observed data and the intuitively perceived ideas. Although he was opposed to the stoic materialism in the Utilitarianism, he thought that the pure idealism of Schelling was equally divorced from reality (Preyer, 49-50). The balance, or tempered Romanticism, that Whewell espoused--and which characterizes the outlook of the Cambridge scientific community of the 1830's-- could be found in Humboldt.

When young Darwin completed his undergraduate years at Cambridge, which included extensive interaction with members of the English scientific community, he had become an adherent of tempered Romanticism himself. He mentions two books in his parting reflections in the "Beagle" diary: Humboldt's Personal Narrative, and Herschel's Preliminary

Discourse. His reference to "cravings" that are independent of corporeal satisfaction, a spiritual hunger for intimate contact with nature's processes, shows how carefully he had read Herschel, particularly the discussion of "cravings in which the senses have no part." (PD, 3) Herschel asserted that man is a speculative being who:

> contemplates the world, and the objects around him, not with a passive, indifferent gaze, as a set of phenomena in which he has no further interest than as they affect his immediate situation, and can be rendered subservient to his comfort, but as a system disposed with order and design. (PD, 4)

This subtle condemnation of the utilitarian view of nature is one that parallels Preyer's characterization of Romantic inclinations in the community of English scientists. But there is balance, too, with the Baconian tradition via the Enlightenment (including Benthamites). Note how Herschel's deism, evident in his assertion of a designed system, is posited without conflict, along with a Romantic emphasis on the importance of observer participation and impulses in the quest to understand nature. The cravings that go beyond the subservience of nature are, for Herschel, of a "higher rank" (PD, 3).

Herschel's discussion, and Darwin's remarks in reference to it, suggest that neither man believed there to be an inherent incompatibility of Enlightenment principles and Romantic sensibilities. Herschel was Baconian enough not to

reject the Enlightenment as such, yet he also recognized the importance of non-material aspects in the human experience for the practicing scientist. Darwin too, in his discussion of the reasons and merits for taking a voyage such as he did, insisted that imagination is as important to the naturalist as a good foundation in botany.

> [A] traveller must be a botanist, for in all views plants form the chief embellishment. Group masses of naked rocks, even in the wildest forms; for a time they may afford a sublime spectacle, but they will soon grow monotonous; paint them with bright and varied colours, they will become fantastick; clothe them with vegetation, they must form, at least a decent, if not a most beautiful picture. (BD, 443)

For Darwin, it was vegetation in particular which excited his imagination. His description of the botanist-traveller, not unlike a description of a painter, suggests that one's knowledge of the plant kingdom will aid in the painting, or creation, of one's experience of nature. Darwin believed that the attainment of scientific understanding, e.g. botany, directly served to enhance the intuitive, creative faculties of the mind for a fuller experience of nature.

The predominant idea of balancing careful observation with the attendant intuition of the observer constituted the influence of Romantic science on the English scientific community in the first half of the nineteenth-century, at least. Their acceptance that non-material aspects of life are essential in the way one experiences the world shows

that Romanticism--at Cambridge, the German tradition of Romantic science in particular--had a key role in this community's reaction against the reductionistic and materialistic implications of utilitarianism. The balance stressed by Whewell is suggested in the opening pages of Herschel's Preliminary Discourse. For Darwin, the prime exemplar of balanced science was Humboldt's combination of diligent empirical research by a researcher who was constantly aware of his own emotional and spiritual reactions to nature. Darwin's emerging sense of scientific maturity on the "Beagle," and the idea that he would be an active contributor to the scientific community upon his return, was for him no cause to abandon his Romantic sensibilities: Indeed, he shared these sensibilities with the group of scientists he was striving to join.

Chapter 1: Humboldtian Romantic Science

Humboldt intended, in his Personal Narrative, to give not only detailed descriptions of the geological, botanical, and zoological formations he observed, but also to infuse his narrative style with the constant awareness of himself, as a naturalist-observer encountering the tropics. In the introduction to this immense work, Humboldt first tells the reader that he hopes to contribute to the progress of several branches of science by his painstaking observations, descriptions, and measurements (PN, x). He then justifies his narrative style in terms of what he thought readers would want from a travelling naturalist. "It is the traveller himself whom we continually desire to see in contact with the objects which surround him; when a local tint is diffused over the description of a country and its inhabitants" (PN, xx). Humboldt tried to provide "local tint" by describing the things that appeared to him on his journeys in the order in which they appeared to him and in relation to the sensations he felt when encountering them. This style was essential, he thought, for the composition of such a work; for if he had only offered page after page of empirical data, the Personal Narrative would have been less personal, less a work of literature, and more a resource of tables and charts of information.

* * *

The work that Humboldt did write, however, was both a work of literature--in the sense of something to read for enjoyment--and a resource for the travelling naturalist. Because Humboldt maintained the awareness of the presence of the observer in contact with the objects of nature, any naturalist following in his footsteps, after reading the Personal Narrative, would have experienced a preliminary sense of what it would be like to set foot in, for example, the Canary Islands or to view for the first time the peak of Tenerife. "The pumice-stone, illumined by the first rays of the sun, reflected a reddish light, like that which tinges the summits of the higher Alps. This light by degrees becomes dazzlingly white; and deceived like most travellers, we thought that the peak was still covered with snow" (PN, 47). Humboldt's first impression of Tenerife is described in terms of artistic appeal. He narrated the changing appearance of the mountain over time, as the rising sun transformed the peak from a "reddish tinge" to "dazzlingly white," so as give an account of what the observer experienced, rather than merely listing the types of stone found on the face of the mountain. Humboldt chose to represent his study of nature in the form of a personal narrative because of the way that style enhanced the

awareness that there is always an observer on which the wonders of nature are being impressed. In so doing he joined the Romantic critique of the heavy empiricism associated with the Enlightenment.

The context of Humboldt's work is embedded in the German Romantic movement, specifically the philosophy of nature, in which the study of nature was elevated from a mechanistic understanding to subjective speculation. The tradition of the Newtonian Enlightenment, to which the early proponents of Romantic science objected, embraced a mechanistic interpretation of phenomena and assumed that things in nature could be atomized and viewed in isolation. The Romantic view of nature, as proposed by Humboldt, Friedrich Schelling, and Johan Wolfgang von Goethe, was one that viewed individual observers as bringing a perspective of their own into the encounter with the natural world. In other words, the subjective, spiritual experience was an essential part of understanding the workings of nature in Romantic Science because the individual observer was considered an integral part of nature, too. We must look inward, in the Romantic view, to make sense of the world around us.

Naturphilosophie, Schelling's Romantic nature philosophy, was an early response to the Enlightenment tradition of "classical" (rigidly empirical) science and supported the idea that the subjective experience of nature, which he

considered as a unified, organic whole, was an essential part of knowing it. "Nature only charms and delights us by that with which we have ourselves invested her" (quoted in Bruhns, 194). The visible forms in nature were regarded as merely one aspect in Naturphilosophie, and the aesthetic experience of the investigator, like the landscape painter, could transcend Reason's limitations and "grasp the underlying unities of Nature" (Nicolson, 180). The assumption is that nature is a unity, despite the distinctions that present themselves to the senses. To sense the sublime, via the intuition and imagination of the observer, according to Naturphilosophie, was to have a more meaningful encounter with nature than one could with the Enlightenment approach. Naturphilosophie was Schelling's orientation to nature whereby one views:

> the holy of holies, where burns in eternal and original unity, as if in a single flame, that which in nature and history is rent asunder, and in life and action no less than in thought, must for ever fly apart. (Cunningham and Jardine, 3)

The spirit and the intellect are what fly apart in the temporal realm of human history. For Schelling, it is the experience of the sublime that gives the glimpse of the original unity of all nature and the observer as a part of it.

Though his overall orientation to the study of nature was akin to Schelling's, Humboldt's methods of meticulous data collection and experimentation had given him the reputation

for being an empiricist among the Romantic intellectual community of Germany at the turn of the nineteenth-century. Schelling sent Humboldt word of his new philosophy after Humboldt's return from the Americas in 1804. Calling him an "empirical scientific investigator," Schelling wished to convince Humboldt that their approaches were not incompatible. (Bruhns, 203)

> Reason and experience can never be more than apparently opposed, and I have therefore a firm conviction that you will not fail to notice the most surprising agreement between theory and experiment in many points of the new philosophy. (quoted in Bruhns, 203)

By "reason" Schelling means the theoretical, Natur-philosophie approach to nature via the intuitive capacities of the observer. This, he believed, is no more than "apparently" opposed to the "experience" of empirical observations and experimentation, in which he considered Humboldt to be grounded.

Humboldt could only agree. In his response to Schelling's letter, Humboldt clarified his emphasis on experience, saying that pure abstract reasoning was often prone to becoming divorced from reality. However, he was committed to the overall Romantic vision of the role of the imaginative faculties of the observer in nature: "Though habitually contemplating nature in her external aspect, there is no one possessed of greater admiration than myself for the creations educed from the depth and fulness of human

thought" (quoted in Bruhns, 204). Humboldt's view of himself as "habitually" concerned with the external appearances, hence empirical, aspect of nature, is tempered by his appreciation of the intuitive capacities to inform his encounters with nature. The Personal Narrative, which is loaded with charts and tables of measurements as well as description, reflects this balance between the empirical and the subjective approaches. It was not the data, however, that was so appealing to a young naturalist like Darwin. It was, rather, the prose of Humboldt's descriptions that resonated within Darwin's circle at Cambridge.

Goethe, another of Humboldt's friends, shared his view of a unified nature that guided his approach to scientific investigation. Goethe emphasized the Ideal in nature and the expression of his view is found in his concept of the "urpflanze." Urpflanze, or "original plant," was his term for the ideal form which permeates all of nature in variations. This "original plant," or the primordial form of all plants, was, for Goethe, a unity in nature that could only be intuited, and imagined. One dramatic example of how Goethe's orientation to Nature and scientific inquiry worked is his discovery of the inter-maxillary bone in the human skull. "This was not like finding a little bone which nobody had noticed before, rather it was a matter of identifying a part of our skull with something much more prominent in other animals" (quoted in Cunningham and

Jardine, 16). Goethe's perception of unity and harmony in nature disposed him to notice a feature of the human skull common among many animals. With a sense of an ideal form, in this case the primordial *ur*-maxillary of the *ur*-animal, Goethe was able to relate its variations among animals and advance anatomical science. This is one example of Goethe's overall vision of science in which the sensitive observer has the Ideal, (*ur*-animals and *ur*-plants), and with it will be able to percieve interconnections in nature that remain obscure to pure empiricists. The aspects of Goethe's science which made it Romantic and related to Humboldt's science are that the Ideal is real and that it exists in the spirit of the observer as the connection to nature.

Humboldt and Goethe's friendship and their shared passion for scientific inquiry were complementary. Humboldt considered Goethe a serious scientist and, above all, an exemplary describer of nature. In his book *Kosmos*, written in the years 1845-1859, Humboldt expressed his admiration for the poet.

> Where is the nation of the imaginative South who might not envy us our great master of poetic art, whose works are deeply imbued with an intense love of nature displayed with equal fervor in the "Sorrows of Werther," the "Reminiscences of Italy," the Metamorphoses of Plants," and the Miscellaneous Poems"? Who has so eloquently incited kindred minds "To unravel the profound mysteries of the universe," and renew the bond by which, in the primitive ages of the world, philosophy, physical science, and poetry, were united? (Bruhns, 177)

Humboldt himself waxes poetic while praising Goethe's belief that philosophy and science are reunited in poetry. Goethe, too, had high esteem for his friend and found Humboldt's passion for scientific inquiry infectious. In a letter to Schiller, Goethe wrote in 1797, "During Humboldt's visit my time has been usefully and agreeably spent; his presence has had the effect of arousing from its winter sleep my taste for natural science" (quoted in Bruhns, 167). Their praise of each other reflects their complementary strengths: Goethe saw in Humboldt a zeal for careful scientific investigation and experimentation, while Humboldt recognized Goethe's literary genius which he sought to cultivate in his own writing.

Humboldt chose to use his literary skills to represent his study of nature in the form of a "personal narrative" in order to impart to the reader a sense of sublimity when facing the vast beauty of natural surroundings. The sublime was that sense, for Romantics, in which the observer perceives the unity of nature and feels himself to be a part of it. In his effort to give the reader a description of the full scope of sensations, Humboldt found cause to warn kindred spirits of being overwhelmed. In the context of the tropical scenery of the Canary Islands, Humboldt expressed his vexation with being unable to give full attention to everything that attracted his eye and his mind.

> Persons who are passionately fond of nature and the arts feel the same sensations, when they travel through Switzerland and Italy. Enabled to see but a small portion of the objects which allure them, they are disturbed in their enjoyments by the restraints they impose on themselves at every stop. (PN, 60)

Humboldt is puzzling here, for one would expect an ardent naturalist and philosopher to be in a state of bliss when within the splendor of the tropics. But his uneasiness is caused by the sense of the sublime which is perhaps forbidding of the desire to focus on the particulars of nature's abundance. It is significant that Humboldt grouped nature and the arts together for it betrays his Romantic view that, like the expressive arts, the study of nature is dependent upon the subjective experience and interpretation of one's surroundings--recall that Darwin, too, likened his own naturalizing to the painting of a picture.

Humboldt's success as a writer lay in his ability to express the sublime, but more specifically, his talent as a naturalist was in his ability to write about the sensations peculiar to those "fond of nature and the arts." The Personal Narrative drew admiration from Darwin and the English scientific community of the 1820's and 1830's because Humboldt successfully appealed to the affinities of Romantically inclined naturalists there. All of Darwin's expectations, he admitted on the last day of the "Beagle" voyage, were derived from Humboldt (BD, 443).

Chapter 2: Darwin as Nature Writer

From the first seasick days as the "Beagle" approached the Canary Islands to the very last day on board, Darwin never tired of Humboldt's Personal Narrative. While it is uncertain whether Darwin was explicitly aware of the philosophical agenda of the Romantic Scientists in Germany at the turn of the nineteenth-century, he often expressed delight in the Personal Narrative and adopted Humboldt's style when writing his own diary. This style was immediately recognized by members of his family to whom he sent installments of the diary during the voyage. In spite of occasional criticism that he was aping Humboldt, Darwin continued to use the narrative form in which natural surroundings are described from the perspective of his subjective experiences.

One of Darwin's significant developments over the course of the five-year journey was his emergence as a naturalist writer. Darwin began to think of his diary as a piece of literature in the second year of the voyage when his sisters made him aware that the installments were being read aloud in the family parlor and sent further to his cousins for their reading pleasure (CP, 253). By the end of the voyage Darwin was beginning to consider publishing his diary, either independently or as a part of Captain Robert Fitzroy's account of the voyage. For his development as a

writer Darwin owed much to Humboldt, whose example of nature writing Darwin thought unmatched, and to which he continually referred in his excursions in and around the tropics.

However, a problem arose in the last months of the voyage when Darwin began to prepare his notes for the composition of scientific manuscripts. He realized that the kind of writing he had been doing, i.e., a Humboldtian Romantic style of nature description, would not meet the expectations of the English scientific community back home. Though the Cambridge segment of that community had rejected Benthamite Utilitarianism and had fostered interest in the German Romantic movement, they were still steeped in the empirical tradition of the Baconian/Newtonian Enlightenment. This tradition called for something more like Herschel's scheme of scientific advancement rather than mere nature description; it called for the empirical rigor of a systematic presentation for the purpose of the establishment of general principles and the application of such principles to various branches of science. For Darwin, this was a new intellectual challenge.

* * *

An early example of Humboldt's influence on Darwin was a direct one as the "Beagle" approached Darwin's long awaited

Canary Islands. It was Humboldt's description of the Canary Islands, and specifically the volcanic mountain peak of Tenerife, that had first stimulated Darwin's desire to visit the tropics. Coincidentally, the "Beagle's" first stop of her voyage was the same Canary Islands. Whether Darwin thought this was coincidence, providence, or destiny is unimportant compared to the sense he had that he was following in Humboldt's footsteps, and with high anticipation. "I spent a very pleasant afternoon on the sofa, either talking to the Captain or reading Humboldt's glowing accounts of tropical scenery. Nothing could be better adapted for cheering the heart of a sea-sick man" (BD, 20). This passage, from the tenth day of the voyage, not only accounts the first impressions of ship-board life of a personal guest of the captain, but also that Darwin was preparing for his first glimpse of the tropics by re-reading Humboldt. One week later the "Beagle" was within sight of "this long wished for object of my ambition" (BD, 21). Since his first reading of Humboldt, the peak of Tenerife had been a mythical place that, because of Humboldt's descriptions, inspired the young naturalist to commit the next five years of his life to a ship that would take him to the tropics and around the world.[9]

During the voyage, and much to the historian's advantage, Darwin kept elaborate notes and journals of his experiences and explorations, the most valuable of which is his diary.

Significantly, he began to regularly send his diary home in six-month installments, both to ensure its preservation, and so that his family could enjoy the accounts of his travels.(CP, 226-7) When writing to his sister Caroline, Darwin ascribed great importance to his "journal" because it was to be his most reliable record of his experiences.

> Be sure you mention the receiving of my journal, as anyhow to me it will [be] of considerable future interest as it [is] an exact record of all my first impressions, & such a set vivid ones they have been, must make this period of my life always one of interest to myself. - If you speak quite sincerely, - I should be glad to have your criticisms.(CP, 225-7)

That Darwin invited criticism from his sister suggests that he was concerned not only for the journal's safe-keeping, but also for its literary value. His diary was of great interest back home, and the portions he sent were read aloud by his sisters to the family and forwarded to cousins for their reading pleasure as well. His sister Catherine responded to the first installment encouragingly, saying that his descriptions were "most excellent, and gave me most lively pleasure in reading them" (CP, 253-5). It is unclear whom Darwin thought his audience was in the first six months of journal writing. However, after reading the first responses in November of 1832, there can be no doubt that Darwin knew his writing would be read aloud: Therefore, Darwin's subsequent entries would require some

thought as to their composition if the "journal" was to be a piece of literature.

Darwin's continued journal writing maintained a Humboldtian flair in his nature description. If Humboldt had such a charm on Darwin, perhaps the family would be similarly affected by his attempts at poetical descriptions. One year after sending home a second instalment, Charles received the requested criticism from Caroline.

> I thought in the first part (of this last journal) that you had, probably from reading so much of Humboldt, got his phraseology & occasionally made use of the kind of flowery french expressions which he uses, instead of your own simple straight forward & far more agreeable style. I have no doubt you have without perceiving it got to embody your ideas in his poetical language. (CP, 345)

Although we may not ascribe much credit to Caroline as a literary critic, Charles may have done so, and he replied that they were perfectly just criticisms. (CP, 392) But Caroline was right about Darwin's absorption of not merely Humboldt's style, but his way of looking at nature. Darwin admitted at the end of the voyage that his impressions of the tropics, in particular, were dependant on preconceptions he held before he got there: "all mine were taken from the vivid descriptions in the Personal Narrative" (BD, 443). Both Charles and Caroline recognized the significance of the impact on his writing about tropical nature. Darwin,

however, gave no indication that he thought the Humboldtian influence was something inhibiting.

Darwin may have been paying lip-service to his sister when he remarked that her criticism was valid, for he remained committed to his new descriptive technique. In the summer of 1834 the "Beagle" sailed down the Atlantic coast of South America to its cold southern tip, Tierra del Fuego, and was headed North on the Pacific side in July when Darwin caught up with his mail, and Caroline's letter, in Valparaiso. Darwin was cheered by his return to the tropics after a less than pleasurable time in Tierra del Fuego. In the first entry in his diary a day or two after receiving Caroline's letter, his Humboldtian Romantic style of viewing nature was still strong.

> I have taken several long walks, but I have not ceased to be surprised to find one day after another as fine as the foregoing, - what a difference does climate make in the enjoyment of life. - How opposite are the sensations, when viewing black mountains half enveloped in clouds, & seeing another range through the light blue haze of a fine day: the one for a time may be very sublime, the other is all gayety & happy life. (BD, 249)

Darwin acknowledged the effect of nature on his emotional state which presumes that he believed his audience wanted, as Humboldt insisted in his work, to see the observer in his environment. Specifically, Charles was making a distinction between the kinds of feelings provoked by encounters with

different environments. Darwin, in the Humboldtian fashion, strived to relate the experience of viewing the Cordillera Mountains in terms of its effect on his emotions. That he did this only days after reading Caroline's letter suggests that Charles did not sacrifice his acquired style of placing himself in his nature description.

While he remained conscious of the task of naturalist writing to the end of the "Beagle" voyage, during the last four months Darwin's thoughts, along with the ship, turned homeward. Naturally, he was envisioning the projects he would undertake after returning to England. In April 1836, while rounding the southern tip of Africa on the last leg of the trip, he wrote Caroline that he was arranging and rewriting his geological notes from which he would publish a journal of his research.

> I am just now beginning to discover the difficulty of expressing one's ideas on paper. As long as it consists solely of description it is pretty easy; but where reasoning comes into play, to make a proper connection, a clearness & a moderate fluency, is to me, as I have said, a difficulty of which I had no idea.(CP, 495)

It seems remarkable to read from a man who had already written 275 pages in his shipboard diary that he experienced difficulty expressing his ideas. Perhaps Charles believed his writing was inadequate in comparison to Humboldt's titanic example, which was his standard of good nature

description that made the "proper connections." It is also possible that the writing Humboldt offered was not the kind of writing for a scientific manuscript to submit to the scientific community back home. Darwin's scientific activities and aspirations are taken up in the next chapter.

As the voyage wound down, Captain Fitzroy informed Darwin of his intent to publish a travel narrative and requested the use of Charles' diary to mingle with his own. Darwin was, at this time, totally compliant with this idea for, it seems, he underestimated the worth of his diary for any but himself and his family. "Of course I have said I am perfectly willing, if he wants materials; or thinks the chit-chat details of my journal are any ways worth publishing" (CP, 496). Darwin, in this remark to Caroline, might have been politely dismissing his creative urges that found expression in his nature description as "chit-chat" details, because if he patterned his diary after Humboldt's example, then there is reason to believe that he was pleased with the manner in which he had written the journal. His diary was eventually published as a companion volume of a set published with Fitzroy and the captain of the H.M.S. Adventure, P. Parker King, in 1839.[10] Subsequent editions of Darwin's portion were published separately and came to be called the Journal of Researches (1839 and 1845). Much later in life he said of it: "The success of this my first literary child always tickles my vanity more than that of

any of my other works" (Autobiography, 142).

Darwin's writing of his diary was a process influenced by his reading of Humboldt's Personal Narrative. It is possible but not evident that he consciously chose to write about nature from a personal, subjective perspective because he was mindful of the Romantic Science agenda and wished to be a critic of the Enlightenment perspective. It is more plausible, however, that Charles was imitating Humboldt's *Personal Narrative* when writing his diary, because Humboldt had such a profound impact on the way he viewed the tropics during the voyage. In the early going of the voyage, Darwin intended the diary to be a record of his "impressions" to be referred to after his return. After the first year of the voyage, he was made aware of his family's delight in reading the first portion of the diary and thereafter was conscious of an audience as he wrote further entries. In 1833, sister Caroline poignantly observed a Humboldtian influence in Darwin's writing and criticized her brother's "flowery French prose," yet no significant change in Darwin's subsequent journal writing occurs.

In the last year of the voyage Darwin was mindful of the possible publication of his writing. Whether Darwin's nature writing was to be in the footnotes to Captain Fitzroy's travel narrative or independently published, he began to organize his notes from five years of observation and collection only to realize the difficulty in connecting

his scientific ideas about the workings of nature with his descriptive writing. Darwin's problem in 1836 regarding the writing of "connected ideas" on nature, in the home stretch of the long journey, raises questions about his understanding of science in general and the connection of its various branches in the narrative form. It also reflects a maturity, for this type of problem does not belong to an inexperienced freshman. Darwin considered his primary purpose on the voyage to be geological observation, although he collected large amounts of information and specimens from the botanical and animal worlds. To the extent that he was able to connect ideas about various branches of science is due to a development that occurred during the "Beagle" voyage.

Chapter 3: Darwin's Apprenticeship

When the "Beagle" left England in late 1831, Darwin was an extremely enthusiastic observer of nature, but he was, as yet, an unpracticed scientist. At the outset, Darwin thought geology would be his chief pursuit during the voyage, even though his only practical experience in the field was a three-week crash course with the professor of geology, Adam Sedgwick, on an expedition in Wales. What Darwin offered in lieu of expertise, however, was data collection. For five years he gathered enormous amounts of geological information from South America, as well as numerous cases of animal and botanical specimens which he sent home, like his journal, in installments for safe-keeping.

Henslow made Darwin aware that the "Beagle" voyage would be a great opportunity to contribute to the body of scientific knowledge. In addition to goading the young man to avail himself of every opportunity to collect data, Henslow arranged for Darwin to accompany Sedgwick on the Welsh expedition before the voyage, and also oversaw the reception of the cases and bottles of specimens sent back from the "Beagle." Darwin's maturation into someone who could contribute to various fields of science is given voice in his letters to his mentor, which bear the character of an

apprentice seeking the approval of his master.

John Herschel's Preliminary Discourse, which Darwin read with great relish in the year before the voyage, provided another way in which the young naturalist was made aware of his opportunity to help expand scientific knowledge. This book described a program for the advancement of science via the hypothetico-deductive method, and how all naturalists, regardless of expertise, could aid in the process of expanding human knowledge of nature.

Throughout the journey Darwin continually collected geological data and specimens of all kinds from every region he visited. His view of nature and his own work in the early part of the voyage, which can be characterized as a kind of blind collecting, was dominated by the Humboldtian, Romantic orientation that he had gleaned from reading the *Personal Narrative*. As the voyage progressed, Darwin changed from a merely enthusiastic gatherer of data into a mature, speculative natural scientist in the way Herschel outlined. Herschel's depiction of the more mature scientist engaged in speculation and more directed observations, i.e., looking for particular phenomenon that would challenge a given theory, paralleled Darwin's experience on the "Beagle." In particular, Darwin gained confidence as a geologist during the voyage, principally because he had a new and highly debated geological framework, a working theory, with which he observed and interpreted the

formations of South America. Lyell's Principles of Geology (1830-3) argued that geological formations were created by processes existing today and not by a diluvian catastrophe, as was believed by many, including Henslow.[11] Darwin became gradually convinced by his own observations during the voyage that Lyell's framework conformed to what he observed in South America. Darwin became increasingly comfortable in describing and interpreting the geological formations he saw and used his increasing understanding of geology as a basis from which he speculated on the formation of coral reefs in the South Pacific.

The three main and interdependent influences on Darwin as a budding scientific investigator during the voyage, therefore, were Herschel's book, Henslow's mentor status, and Lyell's theory of geology. Herschel's program for the advancement of the sciences provided the framework by which Darwin could chart his own progress as a scientist. Darwin's letters to Henslow indicate growing confidence and competence, especially in geology, with each successive letter. Lyell's geological theory provided the theoretical model by which Darwin made his observations, and through which he eventually interpreted the geology of South America. This Lyellian lens also became the basis of Darwin's successful speculations in other branches of science. The maturity of his scientific activities, in the Herschelian sense, was made possible by Darwin's use of

Lyell's gradualistic theory of geological formations, and by Henslow as a mentor who would comment (via letters) on Darwin's progress as his apprentice.

* * *

The boundless passion for the study of nature that Darwin exhibited on the "Beagle" had its origins in his enthusiastic curiosity for the outdoors as a child, when he liked nothing more than to be on horseback, charging through the bracken in pursuit of birds and insects. (Desmond and Moore, 14-20) His early enthusiasm, however, should not be mistaken for a romantic, pastoral sensibility; he was compelled mainly by the prospect of bagging as many birds as possible, appropriate of a young gentleman-to-be. More akin to the study of nature, however, was his considerable insect collection begun in his tenth year to which he continually added throughout his teens, his years at Cambridge, and on board the "Beagle." At the age of twelve he joined his older brother Erasmus in setting up a rather elaborate chemistry lab in the tool shed. Throughout his teen years Charles developed an obsession for chemistry, and after Erasmus went away to Cambridge he was criticized by his prep-school master for spending more time making gaseous explosions in the shed than studying the classical

curriculum. (Desmond and Moore, 17-8)

Darwin's studies at Cambridge propelled him into science much less than did his social associations with his cousin William Darwin Fox and his mentor, John S. Henslow (Ruse, 33). Fox introduced Charles to the "sport" of "entemologizing" which was sweeping Cambridge (Desmond and Moore, 58). Not unfamiliar with insects, Darwin eagerly joined the competition with other students and faculty to possess and identify all of England's species. Identification of one's insects was essential, therefore entomology manuals had to be consulted, and where those failed to be conclusive one had to ask an expert. Fox began taking Charles to the home of Professor Henslow, the thirty-two year old professor of Botany who held soirees for undergraduates with the common, and extra-curricular, interest of nature and naturalizing. It was at these socials that Darwin became friends with Henslow and, over time, they began walking together on the fertile grounds around Cambridge looking for insects and rare plants.[12]

By way of preparation for the voyage, Henslow arranged for Darwin to join a geological expedition in Wales, led by Adam Sedgwick, the Cambridge professor of Geology. The significance of this three-week trek is immeasurable, for it provided Darwin with field experience which he would use frequently on his excursions in South America. But perhaps of more importance is that the expedition charged Darwin

with the desire to geologize. He said in the first month out to sea: "At present I consider my chief purpose to be geology" (BD, 27). The training he received from Sedgwick impacted Darwin to such an extent that he intended to make it his primary field of study.

Another of Henslow's influential contributions to Darwin's development was his gift of Lyell's Principles of Geology. *Principles* was important for Darwin on the "Beagle" because it provided a working theory of geological formations which he could use in his observations. Whether Lyell was right or not was relatively unimportant in terms of Darwin's maturation as a scientist. The significance was in that Darwin had a theory to test. We know that Henslow did not believe Lyell was right, however, this did not stop him from sending Darwin off to South America with a copy. It is plausible that Henslow recognized the utility of a working theory, right or wrong, for a young scientist. The importance of a working theory for Darwin, however, must be viewed within the context of his overall maturation during the voyage.

Darwin's maturation as a scientist on board the "Beagle" followed a prescription for the advancement of science and scientists set forth by John Herschel. In the Preliminary Discourse, which Darwin read concurrently with Humboldt, Herschel outlined the stages and means of progress for every branch of science. At a time when Darwin was becoming

deliriously excited about the idea of an expedition to tropical climes, the progressive temper of Herschel's Preliminary Discourse was harmonious with his mood.

> To what, then, may we not look forward, when the spirit of scientific enquiry shall spread through those vast regions in which the process of civilization...is actually commenced and in active progress? And what may we not expect from powerful minds called into action...far surpassing that which has hitherto produced the whole harvest of human intellect? (PD, 350-1)

Darwin scored this inspirational passage in his copy at the time when he was trying to generate interest in the Canary Islands expedition. The subsequent change in Darwin's plans to sail to South America with the "Beagle" only made the idea of spreading the spirit of scientific research to "those vast regions" more appropriate. Darwin eagerly proceeded onto the voyage ready to engage in "active progress" and contribute to Herschel's expansive project.

Herschel's program for scientific advancement was a combination of empirical inductive and hypothetico-deductive methods. General laws governing natural phenomena, in the inductive method, become apparent--they are induced--during the collection, classification and categorization of data. "Progress" in a particular branch of science occurs when general principles are shown to incorporate more and more observations. The more general and simple, the more these principles, or laws, explain. Herschel also advocated the

use of the hypothetico-deductive method which takes general laws, arrived at by induction in one branch of science, and applies them to another branch prior to observation. That is, a speculative hypothesis is followed by directed observations. Thus, observation and collection of information is essential to both methods. In "immature sciences" (lacking organizing principles and laws), indiscriminant data collection is required as a prelude to inducing generalizations. In mature sciences, observations are directed to testing hypothetical deductions.

Herschel's formulation of the progress of science was not his own invention, but followed the Baconian tradition of scientific inquiry.[13] Herschel was particularly compelling to Darwin, however, because of the inspiring way he enlisted any and all to assist in the effort of amassing recorded observations.

> There is scarcely any well-informed person, who, if he has but the will, has not also the power to add something essential to the general stock of knowledge, if he will only observe regularly and methodically some particular class of facts which may most excite his attention, or which his situation may best enable him to study with effect. (PD, 133)

Herschel gives the sense that concerted efforts are required for progress in science, as well as the general expansion of all knowledge. He calls upon the particular affinities of a given observer who enjoys investigating phenomena from a

particular branch of science, i.e., "class of facts," and he does so in a manner welcoming of the amateur, like the twenty-two year old Darwin. But he also calls for a "well-informed person" to conduct the recording of information. Some experience is required, according to Herschel, of any who would provide assistance. Darwin's background in insect collection and classification, and his botanical jaunts with Henslow at Cambridge were experiences, however informal, that made him somewhat sensitive to a variety of classes of facts. He must have felt well-suited to participate in the effort outlined by Herschel.

In the early part of the voyage Darwin's activities, his "naturalizing," fell within Herschel's framework of infant science where "ransacking nature" (PD, 115) is required. Darwin viewed his opportunity to visit South America on the "Beagle" as an obligation to science: "It is a new & pleasant thing for me to be conscious that naturalizing is doing my duty, & that if I neglected that duty I should at the same time neglect what has for some years given me so much pleasure" (BD, 42). There is a sense here that Charles had found his niche, for he recognized the harmony of his own passions with the Herschelian program. There is a posture of responsibility inherent in Darwin's self-awareness. By making naturalizing a "duty," Darwin suggests a belief that he had joined the community of science in Great Britain and intended to participate in its

advancement by exploiting the rare opportunity for an English naturalist to visit the tropics.

Darwin began to capitalize on his opportunity right away, and his early work at specimen collection reveals not only his enthusiasm in the project of advancing science, but also the influence of Humboldt on his early view of the study of nature. The indiscriminant collection, which falls within the "infant" stage of science in Herschel's scheme, can be executed by non-experts and is best characterized as gathering. In the first week out to sea, Darwin rigged a contraption, a kind of plankton net, to the back of the "Beagle" with which he collected anything that happened to float into it. He commented in his diary on the "exquisite" forms and "rich colours," of the vast variety of sea creatures he netted which gave him a "feeling of wonder," (BD, 22) indicating his reliance on the Romantic perspective of Humboldt to bring meaning to his first encounters with nature in the tropics. At this early stage in Darwin's development, his reading of Humboldt was perfectly compatible with his understanding of Herschel's program and his sense of duty to the mission of the English scientific community.

Darwin's primary contact with this scientific community was Henslow, and Charles first letter to him, six months into the voyage, reads like a report to one's superior. In the letter, Darwin expressed his commitment to being as

useful as possible, but he was also fully aware of his relative immaturity.

> The geology was preeminently interesting & I believe quite new: there are some facts on a large scale of upraised coast...that would interest Mr. Lyell. One great source of perplexity to me is an utter ignorance whether I note the right facts & whether they are of sufficient importance to interest others. In the one thing collecting, I cannot go wrong. (CP, 236)

Darwin's attention is towards geology, and he reveals to Henslow that he is using Lyell's theory as a prism for what to observe. Nevertheless, he admits uncertainty about which "facts" are the essential ones for Lyell's geological theory. In other words, Darwin is not mature in the Herschelian sense because his "ignorance" in geological study keeps him from selectively observing the data that directly tests Lyell's hypothesis. And he seems to be prostrating himself before Henslow, wanting to be Herschel's "well-informed" observer. Darwin's default, however, is "collecting," for he knows that there is a place in Herschel's framework for the relatively inexperienced naturalist to merely gather as much information as possible.

Darwin's posture towards Henslow changed decidedly over the next four years. Through his continual work in geology, both in his field excursions in South America and in his studies of Lyell while on the "Beagle," Darwin gained experience and became somewhat competent and rather confident when discussing geology. This transformation

involved Darwin becoming convinced of Lyell's argument that the earth's formations were caused by phenomena currently in process. In fact, his confidence was such that he attempted to convince Henslow that the diluvian model was wrong.

> If when you see my specimens, sections & account, you should think that there is pretty strong presumptive evidence of the above facts: It appears very important: for the structure, & size of this chain (Cordilleras Mts. of the Andes) will bear comparison to any in the world. And that this all should have been produced in so very recent a period is indeed wonderful. In my own mind I am quite convinced of the reality of this. I can any how most conscientiously say, that no previously formed conjecture warped my judgement. As I have described, so did I actually observe the facts. (CP, 443)

Darwin had discovered a bed of shells on a high plateau in the Cordilleras chain of mountains where the shells closely resembled those he had seen down on the beaches of South America. He concluded that the land had been forced up very recently to account for the same kinds of shells in the two places. This interpretation refutes the diluvian model which insists that a catastrophic flood from the distant past caused the formation of continents now in existence. Lyell's model allows for gradual land upheaval and can account for the displaced bed of shells whereas the diluvian model cannot. His devotion to the progress of science and his own progress within Herschel's program has, in his mind, borne fruit. He can now triumphantly offer evidence to

support conclusively - for his judgement was not "warped" by subjective conjecture - the new Lyellian model. His confidence is reflected by the fact that he was able to say to Henslow that the "facts" were observed as they actually existed, independently of any human construct that would distort their meaning: He was suggesting that if Henslow had been there, he could have only come to the same conclusion.

Charles Lyell's theory, of which Darwin was firmly convinced by the end of the voyage, challenged the dominant geological view of the English scientific community of the 1820's and 30's. Principles of Geology suggested a model of gradual and uniform formation of the Earth's geology caused by processes identical to those currently observable. This view directly opposed the idea of a diluvian catastrophe as the explanation of the existing state of the planet, held by most of the Cambridge dons. The subtitle to the work confirmed Lyell's opposition to the catastophist view from the outset: Principles of Geology, Being an Attempt to explain the Former Changes of the Earth's Surface, by Reference to Causes now in Operation. He argued that formations developed uniformly, or without sudden, supernatural degrees of tumult, whereas those holding the catastrophist view looked for evidence of the Deluge. Sedgwick and Henslow were among the catastophists.

Darwin's forthright conversion to Lyellian geology should be viewed within the context of the English scientific

community to which he wished to make contributions and gain acceptance. The community, as represented by the Cambridge professors and the Cambridge Philosophical Society, was a fairly close group who wrote and published papers and books for each other. Among its members with influence on Darwin were Henslow, as well as Herschel. Also, Sedgwick was the Royal Society president when he took Darwin on the Welsh expedition in 1831, and Lyell was president when the "Beagle" returned to England in 1836. Lyell's work was highly respected even if his conclusions were ultimately rejected by many within the community. So when Darwin wrote home to Henslow, claiming that anybody who looked at the Cordilleras would have to credit Lyell for developing a plausible theory, he was in fact making a formal declaration to the scientific community that he believed Lyell's model worked.

Darwin's confident letter to Henslow is also a sign of his emerging maturity as a scientist in the Herschelian program. Herschel highlighted the importance of observers with a general awareness of natural phenomena for progress in all the sciences. Given the "subtlety of nature," he argued, only observers with general awareness would be able to notice the relevance of observations in one field for finding new laws in another field of science. "He will have his eyes as it were opened, that they may be struck at once with any occurrence which, according to received theories,

ought not to happen; for these are the facts which serve as clews to new discoveries" (PD, 132). Darwin, by the fourth year of the voyage, was becoming a well-practiced, general observer with a specialized understanding of issues pertinent to geology. This condition disposed him to better notice things like the deposit of shells high in the Cordilleras. With the Lyellian model, he had a tool to explain their appearance.

Darwin's discovery fits well within the Herschelian model for scientific advancement, and it may be evidence of Darwin's close reading of Herschel's book on the process of scientific discovery. Darwin considered the shells significant because prior observations had "opened his eyes" to the possibility of recent land upheaval. On his ascent to the bed of shells Darwin found petrified coniferous trees in a bed inclined at 70 degrees. He determined from sandstone layers at a smaller angle, deposited after the trees had grown, that they had once been vertical (CP, 441-442). Thus was Darwin suspicious of the elevation of this land, for it seemed to him that it had to have happened since the life of the trees now petrified. Within the diluvian model, the inclined strata with the petrified trees "ought not to happen," and so Darwin selectively searched out other "facts" to support the Lyellian theory he believed would account for his findings.

Darwin's growing confidence was confirmed by Henslow, who

promptly distributed excerpts from Darwin's letter to members of the Cambridge Philosophical Society. Henslow had already given Sedgwick Darwin's letter concerning his observations in the Cordilleras. Later, in the fall of 1835, Sedgwick read excerpts from the letter to the Geological Society in London for he found Darwin's observations "especially interesting to the Geological Society" (Collected Papers, 17). In January 1836, the excerpts were put into a pamphlet and distributed among members of the Cambridge Philosophical Society (Collected Papers, 3-17). Darwin probably guessed that Henslow would share with others what he had found in the Andes and what he thought they meant. But formal presentations of extracts from his letters was high praise indeed. Henslow also sent a pamphlet to Darwin's father, with a prediction that Darwin would one day "reap the reward of...perseverance and take [a] position among the first Naturalists of the day..." (CP, 473). Apparently, Robert Darwin was delighted at this prospect.

In the last year of the voyage, as the "Beagle," along with its compliments' thoughts, turned towards home, Darwin was planning for the publication of scientific manuscripts. Although he kept many notebooks during the voyage, starting in May of 1836 he began to keep the now famous "Red Notebook."[14] Attempts to date the entries in this notebook indicate that Charles had used it for about one year, until

May or June of 1837, (RN, 6-7) and so its entries spanned the time of his transition from life at sea to work back home, and from collecting and observing to speculating and writing. But the latter began at sea, such as Darwin's hypothesizing about coral formations around Australia. He wondered, "How is Lime separated; is it washed from the solid rock by the actions of Springs or more probably by some unknown Volcanic process?" (RN, 38) His speculations about the mingling of sediments on the ocean floor and the phenomenon of lime separation leading to the formation of coral, were oriented to the future: "These reflections might be introduced either in note in Coral Paper or hypothetical origin of some sandstones, as in Australia" (RN, 38). That is, Darwin was posing a scientific problem and offering a hypothetical deduction to include in an as yet unwritten "Coral Paper." Elsewhere in the Red Notebook Darwin also refers to a "Patagonia paper," (RN, 44) a "Rio paper," (RN, 48) and a "Cleavage paper," (RN, 58) all of which are hypothetico-deductive, wide-ranging projects for the future.

It is useful to recall Herschel now, for his conception of the advancement of science, based on the hypothetico-deductive method, relied on the power of speculation. Darwin, in his coral reef speculation, was carrying out the important step for the expansion of knowledge, according to Herschel's plan. Again, Herschel's plan prescribed that the

naturalist concentrate his efforts on a particular branch of science, "a class of facts which excite his attention" (PD, 38). When the theoretical constructs which organize the phenomena of that branch have been understood, the naturalist ought to try to apply those principles to other branches and deduce facts from those principles.

Darwin's speculations on coral reef formation conformed to Herschel's method of hypothetical deduction. He had formulated a theory on coral reef formation based on observations of South American geology--"a class of facts which excite his attention" (PD, 38)--before he ever saw a coral reef. He applied theoretical constructs and observations from a branch of science he knew very intimately by then to a little-known branch, and thus deduced what ought to exist as a hypothesis for subsequent confirmation. Darwin, in his autobiography, admitted that; "No other work of mine was begun in so deductive a spirit as this; for the whole theory was thought out on the west coast of S. America before I had seen a true coral reef" (Autobiography, 127). The "Beagle" left South America in the Fall of 1835 and sailed across the Pacific to New Zealand, Australia and some of the smaller islands of the South Pacific. It was not until he reached the South Pacific that Darwin could test his hypothesis.[15]

Darwin's coral theory was based on the Lyellian assumption of a steady-state globe. Lyell had argued that

there was no net change in the development of the earth's geology; wherever their was elevation, somewhere else on the globe there had to be a corresponding, compensatory subsidence (Ruse, 41-2). Darwin, by 1835 a Lyellian "zealot," (CP, 460) had been studying the elevation of South America in great detail. That he was firmly convinced of the continent's recent upheaval has already been discussed. And in true Lyellian fashion, Darwin posited a corresponding subsidence occurring somewhere in the Pacific ocean. There he hypothesized that coral reef islands actually rested on subsiding land formations compensating the elevation of South America. He confirmed his hypothesis when he reached the Keeting Islands, northwest of Australia, in April 1836. He believed, after investigations, that the whole of all the Keeting Islands had been arranged by many layers of coral growth on top of a huge, volcanic mountain in subsidence (BD, 418).[16] Hence, Lyell's model provided a framework for Darwin's speculations. No matter that Darwin's interpretation of coral reef formations differed from Lyell's; Darwin was confident in his reasoning and the soundness of Lyell's general principles. Shortly after his return to England Darwin sent word of what he had found to Lyell who immediately agreed with his young champion. (CP, 570-1)[17]

Darwin's coral reef speculations represent his most

mature action as a scientist while on the "Beagle." Darwin's awareness of his own maturation manifested itself in his relationship with Henslow. His willingness on several occasions to suggest that Henslow was mistaken on certain points indicates an emerging sense of equal standing with his mentor and full participation in the English scientific community. Darwin's plans to publish manuscripts upon his return also points to a growing confidence that he had something to offer to the advancement of science.

Darwin had been transformed in the course of the "Beagle" voyage. He left home in 1831 a fledgling scientist, an enthusiast pushed out of the English nest to gather all the information and data he came upon in the new worlds visited by the "Beagle." He returned in 1836, confident in the scientific significance of his collections, already acknowledged as a promising geologist, and eager to participate fully in the English scientific community. He was untested upon his departure and resolute upon his return. His transformation into a mature scientist occurred within the framework of Herschel's prescription for the advancement of science.

Chapter 4: Conclusion

When Mark Twain was a boy, growing up on the Mississippi River, he dreamed of becoming a river-boat pilot. To him gaining mastery of that majestic river would be the ultimate accomplishment of his life. Life on the Mississippi, Twain's tribute to the river, is the story of a young man learning the piloting trade. He received an unexpected shock, however, when, after learning every square inch of the river, every bend and shoal, the grand Mississippi loses its magic for the maturing aspirant: "No, the romance and the beauty were all gone from the river. All the value any feature of it had for me now was the amount of usefulness it could furnish toward compassing the safe piloting of a steamboat" (Twain, 1191-2). For Twain, the process of dissecting the river, and thereby reducing the beauty of the whole down to its component parts for the purpose of safely steering a steamboat through it, had ruined the sublime experience of the river. Twain's story, among other things, is a classic Romantic critique of the Enlightenment-Utilitarian view that the value of all things is determined by their simple utility to man's needs.[18]

According to some of the Romantic critiques of the Enlightenment, science tends to have a similar de-sublimating effect on one's experience of nature when its beauty and unity are sacrificed for the purpose of

understanding its minute workings. William Blake's "Newton" depicted the father of the Enlightenment using a compass in search of life's meaning--only to miss entirely the spiritual mystery of the universe surrounding him. Some Romantics, however, thought Blake's criticism of Enlightenment practicality and empiricism too extreme. Both Goethe and Humboldt made scientific inquiries and were attentive to empirical details in spite of Schiller's criticism that such unimaginative methods desecrated nature (Bruhns, 189). In Schiller's view one should always maintain the broad perspective of nature so as to not distort its unity. This debate represented a fundamental tension between the desire for rational understanding and the spiritual desire to experience sublimity and beauty in nature.

Alexander von Humboldt embraced both perspectives and overcame the tension without sacrificing either the understanding of detail or the essentiality of the subjective experience. He was an especially meticulous attendant to the details of nature's workings and strove to observe and record as many phenomenon as possible. His was a more tempered Romanticism which glorified nature, as well as its beholder, by attempting to understand more of the details. As Darwin's constant companion during the voyage of the "Beagle," Humboldt's Personal Narrative paralleled Darwin's perspective in a participatory role for naturalists in scientific investigations of nature. Darwin's view contained elements

of the Romantic perspective, but in a tempered, Humboldtian fashion. For him, studying the minute details of nature served to enhance his appreciation of the whole--the sublime awe experienced by an empirical naturalist who felt reverence for nature's mysteries.

* * *

Darwin had been charged with the desire to travel to the tropics by reading the work of Humboldt. Humboldt exemplified the German Romantic movement in its critique of the Enlightenment tradition of studying nature. His Personal Narrative, which was widely acclaimed within the English scientific community of the 1820's and 30's, bore the Romantic style of nature description that was mindful of the subjective experience of the observer. Humboldt chose to represent his study of nature in the narrative form because he believed that the truths of nature could only be revealed by invoking the subjective, intuitive encounter with a meticulous, empirical approach. This orientation to the study of nature resonated within the English scientific community and impacted Darwin's development into a mature scientist.

During the voyage, Darwin kept an extensive diary

modeled after Humboldt's travel narrative, which, as a safety precaution, he sent back to England in six-month installments. The positive responses to the installments from his sisters, who read it aloud at home and sent it to other members of the family, made Darwin aware that his writing was being treated as a piece of literature. From the outset, he maintained the Humboldtian style of Romantic nature writing even though his sister, Caroline, criticized him for it. For he revered Humboldt and considered his approach to studying and writing about nature appropriate and worthy of imitation.

In addition to becoming a developed nature writer, Darwin emerged from the five year excursion a mature scientist. The "Beagle" voyage served as a kind of apprenticeship for a young man striving to become a contributing member of the guild-like scientific community in England. The evolving relationship with his "master," J.S. Henslow, via written correspondence, gave expression to this coming-of-age. Darwin left England a wide-eyed nature enthusiast, of twenty-two years, with no particular specialty, but with a knack for gathering natural specimens of all kinds. He returned a directed scientist with publishable theories on geology and coral reef formation.

The dynamic of Darwin's maturation followed the program for scientific advancement laid out in Herschel's Preliminary

Discourse. Herschel called upon naturalists to aide in the amassing of data for the purpose of expanding knowledge. His hypothetico-deductive method proposed that one become well versed in a particular branch of scientific inquiry and then attempt to apply principles learned in that branch to other branches. For Darwin, geology was his primary interest during the voyage, and he soon adopted the principles set forth by Charles Lyell in Principles of Geology. There Lyell argued that geological formations were caused gradually by forces currently observable, and not, as most in Henslow's circle believed, by a diluvian catastrophe. Darwin's observations in South America supported Lyell's theory. Darwin then applied his version of the Lyellian model to the phenomenon of coral reef formation, formulated a hypothesis and deduced the facts necessary for its confirmation long before he ever saw a coral reef himself.

Darwin's development as a mature, specializing scientist in the course of the "Beagle" voyage did not diminish or challenge his Romantic sensibilities, however. The community to which he was aspiring was itself influenced by the German Idealist movement. The generation of Darwin's professors who made up that community had, in the second decade of the nineteenth-century, organized themselves in opposition to adherents of extreme Benthamite Utilitarianism at Cambridge. In so doing, they had embraced certain Romantic affinities

which endured into the 1830's. Darwin's Romanticism was a non-combative expression of this general trend in early Victorian Science.

Darwin's maturation as a scientist during the voyage, by way of his increased competency in geology, did not have the effect of demystifying nature in the way Twain's piloting expertise did for him. The danger of losing the sense of the sublime by picking nature apart and analyzing it in detail, never became a problem for Darwin. In fact, at the end of the voyage he believed the converse, that by learning more about the minute workings of nature, one is better disposed to stand in awe of the whole.

> ...there is a growing pleasure in comparing the character of scenery in different countries, which to a certain degree is distinct from merely admiring their beauty. It more depends on an acquaintance with the individual parts of each view: I am strongly induced to believe that as in Music, the person who understands every note will...more thoroughly enjoy the whole; so he who examines each part of (a) fine view may also thoroughly comprehend the full combined effect. (BD, 443)

For Darwin, the Baconian dream of thorough comprehension through the meticulous examination of the individual parts was in concert with connecting spiritually to nature. Perhaps Darwin recognized a valid criticism of some forms of Romanticism which, in the minds of scientists, relegated the encounter with nature to "mere admiration of beauty." That

kind of encounter would be unfulfilling for Darwin. Just as a symphony has a life of its own as a coherent whole, more than a mere sum of the notes, so does nature have a harmonic unity which is enjoyed all the more by those who understand some of its minute workings. Darwin believed, in the same way Humboldt did, that the scientific understanding of natural phenomena enhances the intuitive or spiritual experience of nature. The Darwin of the "Beagle" conducted empirical studies of nature so that he could better revere her.

Endnotes

1. Quotations from Burckhardt and Smith eds., The Correspondence of Charles Darwin, 1985; hereafter abbreviated in citation as CP.

2. Quotations from Humboldt, Personal Narrative, ed. and trans. Ross, 1881; hereafter abbreviated in citation as PN.

3. One notable exception is Sandra Herbert's "Charles Darwin as a prospective geological writer," British Journal for the History of Biology, 1991, in which she effectively examines Darwin's development in the field of Geology, and his preparation of scientific manuscripts, during the voyage.

4. See Kohn, "Theories to Work By: Rejected Theories, Reproduction, and Darwin's Path to Natural Selection." in Studies in the History of Biology, 1980.

5. Quotations from Herschel, Preliminary Discourse, 1830; hereafter abbreviated in citation as PD.

6. Michael Ghiselin has argued, in The Triumph of the Darwinian Method (1969), that Darwin applied the hypothetico-deductive method throughout his life, though he does not, as I do, attribute Herschel's Preliminary Discourse as the primary transmitter of this method. Nevertheless, I emphatically agree with him that "the superficially attractive 'true Baconian method' and induction by simple enumeration fail to account for what scientists actually do" (Ghiselin, 4).

7. Preyer, R. "Romantic Tide Reaches Trinity." in Annals of the New York Academy of Sciences, 1981.

8. Keynes, R. ed., Charles Darwin's Beagle Diary, 1988, hereafter abbreviated in citation as BD.

9. It is, perhaps, ironic that Darwin was unable to climb Tenerife, the longtime object of his desires, due to the quarantine imposed on the ship by the Spanish consul governing the island (BD, 19).

10. Darwin's narrative appeared as the third of a three volume set, in 1839, entitled Narrative of the Surveying Voyages of His Majesty's Ships Adventure and Beagle, Between the Years 1826 and 1836.

11. Henslow had given Lyell's Principles to Charles as a parting gift, on the eve of the voyage. Henslow qualified his recommendation to read it with the inscription: "But on

no account to accept the views therein advocated" (Autobiography, 127).

12. Darwin's "role" when he joined the "Beagle" was not as ship's naturalist, but as the gentleman companion to the Captain. The ship's naturalist was surgeon Robert McCormick who quit the ship in the seventh month due to his diminished status in the wake of the likeable young gentleman who had won the Captain's favor (Desmond and Moore, 123).

13. The frontis piece to the Preliminary Discourse is a drawing of the bust of Francis Bacon.

14. The Red Notebook has become famous because those looking for the first signs of evolutionary thinking in Darwin point to some speculations made therein.

15. Ghiselin describes Darwin's coral reef speculation as an "almost ideal model" of the hypothetico-deductive method, and persuasively demonstrates that Darwin applied the same methodological approach to his later work on natural selection.

16. Darwin speculated on the thickness of the lime bed that would be needed to support his claim. Test borings conducted a century later confirmed his speculations. See Appendix V in *CP*.

17. Darwin eventually published The Structure and Distribution of Coral Reefs in 1842.

18. The idea of using Twain's story as a possible allegory to my topic was proposed by a classmate, Carol Barnes, in 1993.

Bibliography of Primary Sources

Darwin, Charles. Autobiography of Charles Darwin. Ed. Nora Barlow, appears in The Works of Charles Darwin, Eds. Paul H. Barrett and R.B. Freeman, v. 29, 1989.

---. Correspondence of Charles Darwin. 1809-1882. Cambridge (Cambridgeshire); New York: Cambridge University Press, 1985.

---. Charles Darwin's Beagle Diary. Ed. Richard Darwin Keynes, Cambridge: Cambridge University Press, 1988.

---. Charles Darwin's Diary of the H.M.S. "Beagle". Ed. Nora Barlow, New York: Cambridge University Press, 1933; Kraus Reprint Co., 1969.

---. Collected Papers of Charles Darwin. Ed. Paul H. Barrett, Chicago and London: University of Chicago Press, 1977.

---. The Red Notebook of Charles Darwin. Ed. Sandra Herbert, Ithaca: Cornell University Press, 1980.

Hegel, Georg Wilhelm Friedrich. Hegel's Philosophy of Nature; Being Part Two of the Encylopaedic of the Philosophical Sciences. (1830) Trans. A.V. Miller, Cambridge: Clarendon Press, 1970.

Herschel, John F. W. A Preliminary Discourse on the Study of Natural Philosophy. Chicago & London: University of Chicago Press, 1987, reprint facsimile of 1830 edition, Dionysius Lardner's Cabinet Cyclopaedia (1832).

Humboldt, Alexander von. and Aimee Bonpland Personal Narrative of a Journey to the Equinoctial Regions of the New Continent. 3 vols. London: G. Bell & Sons, 1881.

Paley, William. Natural Theology. Charlottsville, Virginia: Ibis Publishing, reprint facsimile of 12th edition, (1st edition, 1804).

Twain, Mark. Illustrated Works of Mark Twain. New York: Avenel Books, 1979.

Bibliography of Secondary Sources

Baumer, Franklin L. Modern European Thought. New York: Macmillan, 1977.

Bowler, Peter J. "Darwinism and the Argument from Design: Suggestions for a Reevaluation." Journal of the History of Biology, v. 10, no.1, 1977, pp. 29-43.

Bruhns, Karl. Life of Alexander von Humboldt. Trans. Jane and Caroline Lassell, 2 vols., London: Longmans, Green and Co., 1873.

Cunningham and Jardine, "System of Transcendental Idealism." Romanticism and the Sciences. eds. Andrew Cunningham and Nicholas Jardine. Cambridge: Cambridge University Press, 1990.

Desmond, Adrian, and James Moore. Darwin. New York: Warner Books, 1991.

Ghiselin, Michael. The Triumph of the Darwinian Method. Chicago: Chicago University Press, 1984.

Gruber, H.E. "Going the Limit: Toward the Construction of Darwin's Theory (1832-39)." in The Darwinian Heritage, ed. D. Kohn. Princeton: Princeton University Press, 1985.

Herbert, Sandra. "Charles Darwin as a prospective geological author." British Journal for the History of Science, v. 24, 1991, pp. 159-192.

Kohn, David ed., The Darwinian Heritage. Princeton, Princeton University Press, 1985.

--- "Theories to work by: Rejected Theories, Reproduction, and Darwin's Path to Natural Selection." Studies in the History of Biology, 1980, pp. 67-[??].

Nicolson, Malcom. "Alexander von Humboldt and the geography of Vegetation." Romanticism and the Sciences. Ed. Andrew Cunningham and Nicholas Jardine. Cambridge: Cambridge University Press, 1990.

Porter, Roy. "Gentlemen and geology: the emergence of a scientific career, 1660-1920". Historical Journal, v. 21, 1978, pp. 809-36.

Preyer, Robert O. "The Romantic Tide Reaches Trinity." Annals of the New York Academy of Sciences, v.360 entitled, "Victorian Science and Victorian Values," Ed. James Paradis and Thomas Postlewaite, 1981.

Ruse, Michael. The Darwinian Revolution. Chicago & London: University of Chicago Press, 1979.

Secord, James A. "The Discovery of a vocation: Darwin's early geology." British Journal of the History of Science. v. 24, 1991, pp. 133-157.

Schwerber, S.S. "John Herschel and Charles Darwin: A Study in Parallel Lives." Journal of the History of Biology, v. 22, no. 1, 1989, pp.1-71.

Sulloway, Frank J. "Darwin and the Galapagos." Biological Journal of the Linnean Society, v. 21, 1984, pp.29-59.

--- "Darwin's Conversion: The Beagle Voyage and its Aftermath." Journal of the History of Biology, v. 16, 1982, pp. 327-398.

Van Duesen, Robert. The Literary Ambitions and Achievements of Alexander von Humboldt. Frankfurt: Herbert Lang Bern, 1971.